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The Hidden Value of Abandoned Applications to the Patent System

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THE HIDDEN VALUE OF ABANDONED APPLICATIONS TO THE PATENT SYSTEM

CHRISTOPHER A. COTROPIA
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THE HIDDEN VALUE OF ABANDONED APPLICATIONS TO THE PATENT SYSTEM

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Abstract: Some inventors abandon their patent applications without ever receiving a patent. Although patent scholars view such abandoned applications as essentially worthless, we question that conventional wisdom. In conducting an empirical analysis of a recently released patent application dataset (in light of a 1999 change requiring publication of most abandoned applications), we find that the United States Patent and Trademark Office (USPTO) often uses abandoned applications as prior art when examining future patent applications. Abandoned applications thus generate an administrative disclosure that prevents the issuance of broader patent rights to later applicants. By narrowing the scope of new patents, abandoned applications perform a public service in limiting exclusivity over any given technological space and opening up more invention space to the public domain, but they do so at an enormous private cost to the abandoner—benefits and costs that have yet to be fully accounted for in the literature.

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NOTE: Because some platforms do not reproduce images, we have archived all graphics herein at https://www.bc.edu/content/dam/bc1/schools/law/pdf/law-review-content/BCLR/61-8/cotropia_schwartz_web_graphics.pdf [<https://perma.cc/5CES-HLM6>].

INTRODUCTION

Some inventors who apply for patents never receive them.¹ After disclosing how to make and use their invention in a formal patent application,² and after the application's publication, these applicants fail³ and abandon their applications, leaving applicants without any intellectual property protection in most cases. The conventional wisdom is that an abandoned published patent application failed due to a deficiency, and is consequently "worthless."⁴ But the underlying technology is not necessarily worthless, and may not have been deficient—what is worthless is only the patent application filed with the United States Patent and Trademark Office (USPTO).⁵ Certainly, the theory goes, these abandoned applications are worthless to the applicant, who jettisoned them without receiving the benefit of the patent bargain.⁶ These applicants publicly disclosed their invention without receiving exclusive—or, really, any—rights.

These abandoned patent applications are lumped together with all other types of "worthless" patents.⁷ Much of the current literature deems the only remaining product of the abandoned applications, the now-public technical disclosure of the invention, worthless as well.⁸ Scholars have debated whether patents serve any technical teaching component at all. Many scholars claim that scientific researchers ignore patents, rendering the disclosure

¹ Mark A. Lemley & Bhaven Sampat, Essay, *Is the Patent Office a Rubber Stamp?*, 58 EMORY L.J. 181, 182 (2008) ("While approximately 75% of all applications result in at least one patent, a significant number of applications are rejected and then finally abandoned by the applicant.").

² 35 U.S.C. § 112(a) (2018) (detailing the requirement that the specification enable the claimed invention).

³ See Michael Carley et al., *What Is the Probability of Receiving a U.S. Patent?*, 17 YALE J.L. & TECH. 203, 209 (2015) ("Applications are considered abandoned if the applicant does not respond to the examiner's decision by the stipulated deadlines or if the applicant expressly requests abandonment."); Lemley & Sampat, *supra* note 1, at 182 (noting that an application can be abandoned after publication).

⁴ Kimberly A. Moore, *Worthless Patents*, 20 BERKELEY TECH. L.J. 1521, 1525–26 (2005).

⁵ Although the value of the application and the value of the underlying technology are distinct, others have used the fact that an application was abandoned as a proxy for the lack of value of the invention itself. See Mark Nowotarski, *Breakthroughs & Abandonment: Patent Abandon Rate Is a Reliable Measure of Speculative Portfolios*, IPWATCHDOG (Sept. 27, 2010), <https://www.ipwatchdog.com/2010/09/27/abandon-rate-measure-speculative-portfolios/id=12633> [<https://perma.cc/98JN-AMTT>].

⁶ The applications may have had some value while pending. See *infra* Part I.A.

⁷ See Moore, *supra* note 4, at 1525–26 (characterizing patents whose maintenance fees are not paid, and thus abandoned, as worthless). Others have discussed abandonment and value in various property contexts. See generally, e.g., Eduardo M. Peñalver, *The Illusory Right to Abandon*, 109 MICH. L. REV. 191 (2010); Lior Jacob Strahilevitz, *The Right to Abandon*, 158 U. PA. L. REV. 355 (2010); Lior Jacob Strahilevitz, *The Right to Destroy*, 114 YALE L.J. 781 (2005).

⁸ See *infra* Part I.C.

portion of the patent bargain an illusion.⁹ By extension, relevant researchers likely ignore an abandoned patent application even more so.

But do abandoned applications have hidden value to the patent system? The popular view, that abandoned applications themselves are worthless, has not been empirically tested. To date, no one has carefully studied abandoned published patent applications to determine their usage by the USPTO and, in turn, their worth. This Article takes advantage of a 1999 legislative change, which publicly disclosed almost all abandoned applications, making them accessible when examining future patent applications.¹⁰ The Article reports the results of a study of the USPTO's use of such abandoned published applications.

Using the recently released Patent Examination Research Dataset with millions of observations, we study abandoned published patent applications. The USPTO Patent Examination Database has granular information on every paper filed or generated during patent prosecution. Using this dataset, we carefully investigate how the USPTO treated these publications upon disclosure and find that the USPTO regarded them as potentially relevant to the examination of other applications. We compare abandoned published patent applications to granted ones and look at how often both are used by the USPTO to assess later applications.¹¹ We also examine the citation by later applicants and examiners in future applications.

Surprisingly, our analysis shows that the USPTO more likely uses abandoned applications as prior art to reject others' patents than issued patents.¹² Patent examiners use abandoned published applications more often than issued patents when issuing anticipation rejections (concluding the applied-for invention is not novel—*i.e.*, it has been done before) and obviousness rejections (concluding the applied-for invention is obvious—*i.e.*, not

⁹ See, e.g., Mark A. Lemley, *Ignoring Patents*, 2008 MICH. ST. L. REV. 19, 21–22 (noting that companies generally ignore patents in all stages of product development: when conducting research and design, when filing their own patents, when launching new products, and even after receiving initial cease-and-desist letters from patent owners).

¹⁰ Prior to the American Inventors Protection Act (AIPA), abandoned applications were kept secret. 35 U.S.C. § 122 (1994).

¹¹ See 37 C.F.R. § 1.104(a)(1) (2019) (“On taking up an application for examination or a patent in a reexamination proceeding, the examiner shall make a thorough study thereof and shall make a thorough investigation of the available prior art relating to the subject matter of the claimed invention.”).

¹² As explained in further detail in Part II.A–B, below, we follow conventional practice of looking at citations based on an issued patent basis. We are currently working on an alternative approach, combining all patent-related documents within a patent family, including all related patents and published applications. That approach may have implications for our understanding of patent citation studies more broadly. Regardless of the implications of that alternative approach, the fact remains that abandoned applications are cited more than previously understood.

enough of a technical advance over what has been done before) in an office action. Beyond just rejections, our study finds that abandoned applications are more likely than issued patents to be cited as relevant by patent examiners during patent prosecution. The office actions require applicants to narrow and amend their claims or include specific arguments as to why the USPTO incorrectly determined that the claims are anticipated or obvious.

Given our empirical findings that the USPTO rejected a large number of applications based on published yet abandoned art, a significant quantity of patent scope was narrowed because of abandoned applications.¹³ These abandoned published applications appear to be quite valuable disclosures, at least from the USPTO's perspective; yet, the applicants received no patent reward. The highly cited applications prevented future applicants from obtaining broader claim scope, preserving invention space in the public domain.¹⁴ Preventing broader patent rights for others is arguably a public service because it limits exclusivity in any given technological space, but it is also potentially a huge private loss that has not been previously recognized in the literature.

Citation by the USPTO has, for many years, been used by economists to determine the value of a patent.¹⁵ Thus, the finding that the USPTO cites abandoned patent applications more often than issued patents presents an enigma for both patent scholars and economists: abandoned published applications, widely considered worthless both to the applicant and society in general, play a larger role in the patent system than previously thought. Our findings suggest that the high usage of these abandoned published applications is because they combine, in one place, various teachings of the prior art. They are a compendium of what has previously been accomplished, now described in a single place: the abandoned published application.

Our findings have important implications for patent law and doctrine. First and most importantly, our findings are relevant to policy debates about

¹³ See *infra* Part III.

¹⁴ See, e.g., *Chem. Found., Inc. v. Gen. Aniline Works, Inc.*, 99 F.2d 276, 277–78 (3d Cir. 1938) (Biggs, J., concurring) (explaining that once the patent application became abandoned, the invention “passed into the public domain”); see also *Kendall v. Winsor*, 62 U.S. (21 How.) 322, 329 (1859) (stating that an inventor may “confer gratuitously the benefits of his ingenuity upon the public”); *Pennock v. Dialogue*, 27 U.S. (2 Pet.) 1, 16 (1829) (noting that a patentee can “abandon his invention, and surrender or dedicate it to the public”).

¹⁵ See, e.g., Adam B. Jaffe & Gaétan de Rassenfosse, *Patent Citation Data in Social Science Research: Overview and Best Practices*, 68 J. ASS'N INFO. SCI. & TECH. 1360, 1371 (2017); Jean O. Lanjouw, Ariel Pakes & Jonathan Putnam, *How to Count Patents and Value Intellectual Property: The Uses of Patent Renewal and Application Data*, 46 J. INDUS. ECON. 405, 417–18 (1998); Manuel Trajtenberg, *A Penny for Your Quotes: Patent Citations and the Value of Innovations*, 21 RAND J. ECON. 172, 173 (1990). See generally, e.g., ADAM B. JAFFE & MANUEL TRAJTENBERG, *PATENTS, CITATIONS, AND INNOVATIONS: A WINDOW ON THE KNOWLEDGE ECONOMY* (2002).

patent disclosure. We find that the USPTO relies upon abandoned applications as a significant source of prior art for rejections. The USPTO decides whether to grant private patent rights to researchers.¹⁶ The USPTO patent examiners are not scientific researchers in the field.¹⁷ They have the relevant technical background, but do not conduct original research. The USPTO patent examiners cite to disclosures, even abandoned patent applications, for prior art. Thus, the patent examiners are reading and using disclosures in patent applications, and the abandoned patent applications are serving a key technical teaching component. This usage of abandoned applications highlights an administrative disclosure function of such published applications.

Our findings also push back against the assumption that abandoned patent applications are commercially worthless. The fact that the USPTO uses these applications to reject later patent applications implies that others found similar technologies to be of enough worth to spend the time and money to both invent and file patent applications in the same technological space.¹⁸ They may have been of little private worth, for whatever reason, to the abandoning patent applicant, but the invention they disclosed is clearly valuable to others in the relevant industry. Our data strongly suggests that the abandoned patent application, through its use in USPTO rejections, clears space for the public to practice technology of interest to many.

The Article proceeds in three parts. In Part I, we outline the patent examination process, the history of using abandoned patent applications in future examinations, and the current literature concluding that such abandoned patent applications, and their disclosures, are worthless.¹⁹ Next, in Part II, we set forth the study design relating to abandoned published patent applications.²⁰ We provide our empirical results in Part III, both comparing how the USPTO treats abandoned applications and issued patents, and identifying some examples of where abandoned applications were used to reject attempts by others to claim exclusivity over the same technological space.²¹

¹⁶ See Michael D. Frakes & Melissa F. Wasserman, *Does the U.S. Patent and Trademark Office Grant Too Many Bad Patents?: Evidence from a Quasi-Experiment*, 67 STAN. L. REV. 613, 618–21 (2015) (explaining the examiner's role in patent examination).

¹⁷ Examiners are properly characterized as “quasi-judicial officials trained in the law and presumed to ‘have some expertise in interpreting the [prior art] references and to be familiar from their work with the level of skill in the art and whose duty it is to issue only valid patents.’” *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 986 (Fed. Cir. 1995) (en banc) (quoting *Am. Hoist & Derrick Co. v. Sowa & Sons, Inc.*, 725 F.2d 1350, 1359 (Fed. Cir. 1984)).

¹⁸ See, e.g., Roberto Fontana et al., *Mapping Technological Trajectories as Patent Citation Networks. An Application to Data Communication Standards*, 18 ECON. INNOVATION & NEW TECH. 311, 320–24 (2009) (using citation to identify areas of telecommunication innovation).

¹⁹ See *infra* Part I.

²⁰ See *infra* Part II.

²¹ See *infra* Part III.

Finally, we discuss implications of these results for both the general worthiness, in some cases, of abandoned patent applications and their illumination of the administrative disclosure aspect of published patent applications.²²

I. BACKGROUND ON PATENT EXAMINATION AND ABANDONED PATENT APPLICATIONS

Section A of this Part explains the process of getting a patent in the United States—patent examination—and how prior patents and published applications are used during patent examination.²³ Section B details how the use of abandoned patent applications by the USPTO to examine subsequent patent applications has changed over time.²⁴ Finally, Section C examines the current thinking on the value, or more so the lack thereof, of abandoned applications in general and their disclosure in particular.²⁵

A. Use of Patents and Published Applications in Patent Examination

In order to get a patent in the United States, an inventor must initially apply for one with the USPTO.²⁶ After an inventor has conceived of an invention,²⁷ he or she prepares a patent application, or has it prepared by a patent attorney or agent.²⁸ A patent application contains an abstract, a detailed description of the invention (typically including drawings which appear on sheets that proceed the textual description), and a series of patent claims.²⁹ The description of the invention is often referred to as the patent's "specification" and includes both a general description of the invention and

²² See *infra* Part III.

²³ See *infra* Part I.A.

²⁴ See *infra* Part I.B.

²⁵ See *infra* Part I.C.

²⁶ 35 U.S.C. § 111(a)(1) ("An application for patent shall be made, or authorized to be made, by the inventor, except as otherwise provided in this title, in writing to the Director.").

²⁷ U.S. PATENT & TRADEMARK OFFICE, MANUAL OF PATENT EXAMINING PROCEDURE § 2138.04(I) (9th ed. rev. Oct. 2019) [hereinafter MPEP] ("The inventor must form a definite and permanent idea of the complete and operable invention to establish conception."); see also *Bosies v. Benedict*, 27 F.3d 539, 542–43 (Fed. Cir. 1994) (ruling that a non-inventor's testimony as to the meaning of a variable in a generic formula written in an inventor's notebook was inadequate as a matter of law to determine the meaning of the variable because the "testimony was not probative of what the inventors conceived").

²⁸ 37 C.F.R. § 1.31 ("An applicant for patent may file and prosecute the applicant's own case, or the applicant may give power of attorney so as to be represented by one or more patent practitioners . . .").

²⁹ A patent application is divided into several sections, each of which provides different types of information regarding the invention. 35 U.S.C. § 111(a)(2) ("Such application shall include— (A) a specification as prescribed by section 112; (B) a drawing as prescribed by section 113; and (C) an oath or declaration as prescribed by section 115.").

specific examples, embodiments, of how the invention can be implemented.³⁰ The patent application ends with a series of patent claims.³¹ The patent claims are detailed, one-sentence descriptions of the invention(s) that the applicant claims to have invented,³² including independent claims and then claims that depend on, and in turn narrow, the independent claims (called dependent claims).³³ The applicant files the patent application with the USPTO.³⁴

The USPTO employs nearly ten thousand patent examiners, most of whom have a scientific, engineering, or other technical background.³⁵ A patent examiner is responsible for evaluating whether a patent application meets the legal requirements to issue as a patent.³⁶ The examiner uses a de-

³⁰ See *id.* § 112; 37 C.F.R. § 1.71(a) (“The specification must include a written description of the invention or discovery and of the manner and process of making and using the same, and is required to be in such full, clear, concise, and exact terms as to enable any person skilled in the art or science to which the invention or discovery appertains, or with which it is most nearly connected, to make and use the same.”); see also 37 C.F.R. §§ 1.11(a), 1.51(b).

³¹ 35 U.S.C. § 112(b) (“The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.”); see also *id.* § 112(c)–(e) (defining the convention by which an inventor must properly draft a claim set).

³² See MPEP, *supra* note 27, § 608.01(m) (“While there is no set statutory form for claims, the present Office practice is to insist that each claim must be the object of a sentence starting with ‘I (or we) claim,’ ‘The invention claimed is’ (or the equivalent).”).

³³ See 35 U.S.C. § 112(c) (“A claim may be written in independent or, if the nature of the case admits, in dependent or multiple dependent form.”).

³⁴ To obtain a valid patent, a patent application as filed must contain a full and clear disclosure of the invention in the manner prescribed by 35 U.S.C. § 112(a).

³⁵ U.S. PATENT & TRADEMARK OFFICE, PERFORMANCE AND ACCOUNTABILITY REPORT FOR FISCAL YEAR 2019, at 12 (2019), <https://www.uspto.gov/sites/default/files/documents/USPTOFY19PAR.pdf> [<https://perma.cc/3PS9-UMLP>]; see also Alden Abbott et al., Regulatory Transparency Project, Crippling the Innovation Economy: Regulatory Overreach at the Patent Office 8 (Aug. 14, 2017) (Intellectual Property Working Group Paper), <https://regproject.org/wp-content/uploads/RTP-Intellectual-Property-Working-Group-Paper.pdf> [<https://perma.cc/K3V8-Y4KZ>] (explaining that patent examiners have backgrounds in science and/or engineering). According to the USPTO, the following responsibilities contribute to the role of an examiner: “[i]ssue [v]alid [p]atents”; “[a]ct as an advocate for the Public”; “serve as advocate/protector of public interest with respect to intellectual property”; “provide direct service and assistance to customers from inside and outside the [USPTO]”; “serve as a judge on patentability with respect to inventions claimed in a patent application under conditions for patentability set forth in Title 35 of the United States Code.” Sue A. Purvis, U.S. Patent & Trademark Office, PowerPoint, The Role of the Patent Examiner 8–9 (Apr. 8, 2013), https://www.uspto.gov/sites/default/files/about/offices/ous/04082013_StonyBrookU.pdf [<https://perma.cc/29TV-V75F>].

³⁶ See MPEP, *supra* note 27, § 706 (stating that after reading the specification and claims, the examiner searches the prior art and then “determine[s] whether the claims define a useful, novel, nonobvious, and enabled invention that has been clearly described in the specification”). See generally *Examination Guidance and Training Materials*, U.S. PAT. & TRADEMARK OFF., <https://www.uspto.gov/patent/laws-and-regulations/examination-policy/examination-guidance-and-training-materials> [<https://perma.cc/LT6Y-H4LA>] (categorizing the available reference guides to highlight their purpose of enhancing the logic used in training).

tailed set of procedures and rules contained in the USPTO's Manual of Patent Examining Procedure (MPEP) during examination.³⁷ The MPEP's individual provisions are based on the patent laws contained in Title 35 of the United States Code and the patent regulations contained in Title 37 of the Code of Federal Regulations.³⁸ The process of obtaining a U.S. patent is known as patent prosecution.³⁹ Patent prosecution includes a series of interactions between the inventor (or the inventor's attorney) and the patent examiner.⁴⁰

After a patent application has been filed, the USPTO conducts an initial review to determine whether the application satisfies the formal requirements, such as whether the applicant filed an oath of invention, and then assigns the application to a patent examiner in an appropriate Group Art Unit for the technological field under which the invention falls.⁴¹ The patent examiner then searches⁴² for prior art, publications printed prior to the patent application's filing date, and prepares an office action that contains his or her analysis regarding patentability.⁴³ It is in this office action that the patent examiner will use prior art, such as prior issued patents or published patent applications in novelty (§ 102) and nonobviousness (§ 103) rejections, to assert that one or more claims have either already been disclosed in the prior art (not novel) or describe only a minor improvement

³⁷ See MPEP, *supra* note 27, at Foreword ("This Manual is published to provide U.S. Patent and Trademark Office (USPTO) patent examiners, applicants, attorneys, agents, and representatives of applicants with a reference work on the practices and procedures relative to the prosecution of patent applications and other proceedings before the USPTO.").

³⁸ See *id.* ("[T]he Manual contains instructions to examiners, as well as other material in the nature of information and interpretation, and outlines the current procedures which the examiners are required or authorized to follow in appropriate cases in the normal examination of a patent application.").

³⁹ See 35 U.S.C. § 133 (setting forth the time in which applicant must "prosecute the application" to avoid being "regarded as abandoned by the parties").

⁴⁰ Mark A. Lemley & Bhaven Sampat, *Examining Patent Examination*, 2010 STAN. TECH. L. REV. 2, 12 (describing the process of patent prosecution as a "continuing negotiation between examiner and applicant . . . [that] does not end with an initial or even final rejection" but rather consists of "[i]nterviews and amendments . . . [that] play an extremely significant role in generating patents, and in limiting the scope of those claims").

⁴¹ MPEP, *supra* note 27, § 2103 (outlining the patent examination process beginning with the initial review procedure); see also *id.* § 903 (describing the process of grouping applications based on their subject matter and noting that "[e]very application, no matter how peculiar or confusing, must be assigned somewhere for examination").

⁴² Patent examiners search on special USPTO databases called the Examiner Automated Search Tool (East) and Web Examiner Search Tool (West). See U.S. PATENT & TRADEMARK OFFICE, PRIOR ART: FREQUENTLY ASKED QUESTIONS 3 (2014), https://www.uspto.gov/sites/default/files/patents/init_events/prior_art_faq20140728.pdf [<https://perma.cc/T97H-FB32>] [hereinafter PRIOR ART: FREQUENTLY ASKED QUESTIONS]. Google also has a patent search engine. GOOGLE PATENTS, <http://patents.google.com> (last visited Oct. 24, 2020).

⁴³ MPEP, *supra* note 27, § 2103.

over the prior art (obvious).⁴⁴ This use of prior art, most commonly prior issued patents or published patent applications, is a fundamental aspect of patent examination. Examiners seek to find prior art that discloses the applied-for invention and, in turn, cite this prior art and use it in an office action to reject one or more pending claims for not meeting the patentability requirements of novelty and/or nonobviousness.⁴⁵

To provide a concrete example, take U.S. Patent Application No. 12/459,756, filed on July 7, 2009 and entitled “Multiple squeaker pet toy” (2009 Squeaker Toy Patent Application).⁴⁶ The patent examiner rejected this application’s claims under 35 U.S.C. § 102 as not novel in light of an earlier published patent application—U.S. Published Patent Application No. 2002/0134318, published on September 26, 2002 and entitled “Squeezable toy with sound-emitting device” (2002 Sound-Emitting Toy Patent Application).⁴⁷ The examiner asserted that the specification of the earlier published 2002 Sound-Emitting Toy Patent Application disclosed all of the elements of the later 2009 Squeaker Toy Patent Application’s claims.⁴⁸ The later 2009 Squeaker Toy Patent Application’s pending claims were then amended,⁴⁹ and the examiner eventually allowed the patent to issue as U.S. Patent No. 9,491,929 on November 15, 2016.⁵⁰ To generalize this usage of an earlier published patent application as prior art in a rejection of a later filed pending patent application, the specification of the earlier published (and filed) patent application was cited and used by the examiner to reject a later filed patent application.⁵¹ In this case, the 2002 Sound-Emitting Toy Patent Applica-

⁴⁴ *Id.*

⁴⁵ *Id.*

⁴⁶ U.S. Patent No. 9,491,929 (issued Nov. 15, 2016 from Application No. 12/459,756).

⁴⁷ Of particular relevance for this Article, this 2002 Sound-Emitting Toy Patent Application was abandoned, and thus never became an issued patent. *See* Notice of Abandonment, U.S. Patent Application No. 10/152,410 (Sept. 24, 2004).

⁴⁸ *See* Non-Final Rejection, U.S. Patent Application No. 12/459,756 (Aug. 31, 2011) (rejecting Claims 1–6, 9, and 10). “Claims 1–5, 9, 10 [were] rejected under 35 U.S.C. § 102(b) as being anticipated by Mann et al. . . .” *Id.* at 2. Further, “Claim 6 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Mann et al.” *Id.* at 4.

⁴⁹ Response After Non-Final Rejection, U.S. Patent Application No. 12/459,756, at 6 (Nov. 30, 2011) (acknowledging the Mann et al. reference does comprise “a first compressible sound-emitting chamber,” while contesting any disclosure of a “second compressible sound-emitting chamber” (emphasis omitted) (quoting *id.* at 2)).

⁵⁰ ‘929 Patent.

⁵¹ MPEP, *supra* note 27, § 2127(I) (“[T]he subject matter of an abandoned application . . . referred to in a prior art U.S. patent . . . may be relied on in a 35 U.S.C. [§] 102(a)(2) or pre-AIA 35 U.S.C. [§] 102(e) rejection based on that patent . . . if the disclosure of the abandoned application is actually included or incorporated by reference in the patent.”).

tion's disclosure in the specification was used by the USPTO to reject the 2009 Squeaker Toy Patent Application's claims.⁵²

A common analogy is drawn between the patent prosecution process and that of a preemption check in academic writing.⁵³ Often editors, when reviewing a submitted article, will search to see if a prior scholarly article already conveys similar insights as the submitted article under review.⁵⁴ If the submitted article is preempted, the editor would cite the prior article in her letter rejecting the submitted article for publication.⁵⁵ In this instance, the submitted article lacks novelty.⁵⁶ An editor may perform an "obviousness" analysis, concluding that the submitted article does not provide enough of a contribution to the literature beyond prior scholarly articles—the "prior art."⁵⁷

In response to a rejection, an applicant can either amend the claims to include aspects of the invention not found in the cited prior art or argue that the patent examiner's analysis is wrong.⁵⁸ The patent examiner then examines the claims again.⁵⁹ The process continues until the claims are allowed,

⁵² The 2009 Squeaker Toy Patent Application was eventually allowed following an examiner interview. See '929 Patent; Examiner-Initiated Interview Summary, U.S. Patent Application No. 12/459,756 (Sept. 15, 2016).

⁵³ See, e.g., Stephen L. Carter, *Academic Tenure and "White Male" Standards: Some Lessons from the Patent Law*, 100 YALE L.J. 2065, 2082–83 (1991).

⁵⁴ *Id.* at 2081–85 (using language of novelty and obviousness in other contexts, and citing to procedures from other disciplines); see also EUGENE VOLOKH, *ACADEMIC LEGAL WRITING: LAW REVIEW ARTICLES, STUDENT NOTES, SEMINAR PAPERS, AND GETTING ON LAW REVIEW* 9 (4th ed. 2010) (arguing that "[g]ood legal scholarship should make (1) a claim that is (2) novel, (3) nonobvious, (4) useful"—the same requirements found in §§ 101, 102, and 103 of the Patent Act). Volokh credits this idea to Carter's 1991 *Yale Law Journal* piece in which Carter writes:

[M]y claim is not that every article must, in effect, deserve a patent if it is to be adjudged a good piece of work; my claim, rather, is that the works of scholarship that can meet the patent test are better—add more to human knowledge—than the works that cannot. So if one wants to argue the relative merits of different scholarly works, the patent law tests of novelty and nonobviousness provide useful and workable starting points.

Carter, *supra* note 53, at 2084. Expanding on this, Volokh adds of the § 101 utility requirement: "It helps if the article is useful—if at least some readers can come away from it with something that they'll find professionally valuable." VOLOKH, *supra*, at 9.

⁵⁵ See VOLOKH, *supra* note 54, at 9.

⁵⁶ See *id.*

⁵⁷ See *id.*

⁵⁸ 37 C.F.R. § 1.111(a)(1) ("If the Office action after the first examination (§ 1.104) is adverse in any respect, the applicant or patent owner, if he or she persists in his or her application for a patent or reexamination proceeding, must reply and request reconsideration or further examination, with or without amendment.").

⁵⁹ *Id.* § 1.550(a) ("After issuance of the *ex parte* reexamination order and expiration of the time for submitting any responses, the examination will be conducted in accordance with §§ 1.104 through 1.116 . . .").

finally rejected, or abandoned by the inventor. If the claims are allowed, a patent will issue. If the claims are rejected, the applicant can appeal to the USPTO's Patent Trial and Appeals Board or continue prosecuting the application by filing a Request for Continued Examination (RCE), permitting further amendment of the claims and continuation of the prosecution process.⁶⁰ The inventor may, through this appeals and refiling process, decide to no longer pursue the patent application and abandon the application either expressly or by not responding within the relevant statutory time period.⁶¹ The patent prosecution process typically takes several years to complete.⁶²

As provided by Title 35 and applicable regulations, the USPTO permits patent applicants to file applications that are related to a pending original application.⁶³ Related applications are denominated divisionals,⁶⁴ continuations,⁶⁵ or continuations-in-part.⁶⁶ All are examined in the same manner as an originally filed application, but are treated as if they were filed on the same date as the originally filed application.⁶⁷ Patent applicants frequently file related applications in the course of patent prosecution.⁶⁸ Patent applicants also may claim priority to foreign filed patent applications (filed in other jurisdictions) or from Patent Cooperation Treaty (PCT) filings.⁶⁹

⁶⁰ See generally MPEP, *supra* note 27, § 2266. Prosecution typically includes two office actions—a non-final and final action—before an RCE needs to be filed to continue prosecution further without abandoning the application. See *id.* § 711.02.

⁶¹ See generally *id.* § 711.

⁶² Across all art units, the average pendency from filing to issuance or abandonment during the fiscal year of 2016 at the USPTO was 25.3 months. U.S. PATENT & TRADEMARK OFFICE, PERFORMANCE AND ACCOUNTABILITY REPORT FOR FISCAL YEAR 2016, at 178 tbl.1 & n.7 (2016), <https://www.uspto.gov/sites/default/files/documents/USPTOFY16PAR.pdf> [<https://perma.cc/N692-JJP3>]. This average excludes design patents. *Id.* 178 n.7.

⁶³ See 35 U.S.C. §§ 119, 120; see also MPEP, *supra* note 27, § 1895.01.

⁶⁴ See MPEP, *supra* note 27, § 201.06 (defining “divisional application” as “[a] later application for an independent or distinct invention, carved out of a nonprovisional application . . . and disclosing and claiming only subject matter disclosed in the earlier or parent application”).

⁶⁵ See *id.* § 201.07 (“A continuation is an application for the invention(s) disclosed in a prior-filed copending nonprovisional application The disclosure presented in the continuation must not include any subject matter which would constitute new matter if submitted as an amendment to the parent application.”).

⁶⁶ *Id.* § 1895-A (“Continuation-in-part applications are generally filed in instances where applicants seek to add matter to the disclosure which is not supported by the disclosure of the international application as originally filed, as new matter may not be added to a U.S. national stage application.”).

⁶⁷ See 35 U.S.C. § 120.

⁶⁸ A continuation application is often filed while a patent application is pending, allowing inventors to modify or add claims to the pending application without affecting its filing date. See 37 C.F.R. § 1.53(b)(2).

⁶⁹ See 35 U.S.C. § 119 (permitting claims of priority to applications filed in a foreign patent office); *id.* § 120 (permitting claims of priority to applications filed in the United States or filed as a PCT application).

Once a patent issue or the underlying patent application is published, it becomes available as prior art for future patent applications.⁷⁰ A patent examiner, when examining a new patent application, may rely on the now-issued patent or published patent application to assert that the applied-for invention under review is not patentable.⁷¹

Continuing with the actual toy patents example discussed above, the 2009 Squeaker Toy Patent Application, which was filed in 2009, was used by a patent examiner in a rejection of U.S. Patent Application No. 12/924,480, filed on September 28, 2010 and entitled “Pet toy containing durable squeaking device” (2010 Pet Toy Patent Application).⁷² The patent examiner in the 2010 Pet Toy Patent Application examination used the 2009 Squeaker Toy Patent Application, in combination with other patents, to reject the pending claims as obvious.⁷³ The 2009 Squeaker Toy Patent Application’s specification, the patent examiner asserted, disclosed aspects of the 2010 Pet Toy Patent Application’s claims that, when combined with other prior art, rendered the claims obvious.⁷⁴ Thus, this example illustrates how, just as a patent application is examined in light of the prior art, that very patent application, once publicly available either through issuance or publication, can become prior art for future patent applications.⁷⁵

Section 102 and 103 rejections based on patent application citations create two different metrics when looking at a patent’s involvement in both being rejected in light of prior art and being used as prior art in future patent applications. When looking at a specific patent or published application (for example, the 2009 Squeaker Toy Patent Application), there are prior patents or published applications cited to reject that very patent.⁷⁶ These are called backward citations.⁷⁷ A backward citation, a prior patent or published appli-

⁷⁰ See generally MPEP, *supra* note 27, § 901 (detailing all references that may qualify as prior art in the course of patent prosecution to determine patentability).

⁷¹ See *id.* § 706 (following review of the pending application, a prior art search for the claimed invention is made and “reviewed and analyzed in conjunction with the state of the prior art to determine whether the claims define a useful, novel, nonobvious, and enabled invention that has been clearly described in the specification”).

⁷² U.S. Patent Application No. 12/924,480 (filed Sept. 28, 2010).

⁷³ Non-Final Rejection, U.S. Patent Application No. 12/924,480 (Sept. 29, 2014).

⁷⁴ *Id.* at 6–7.

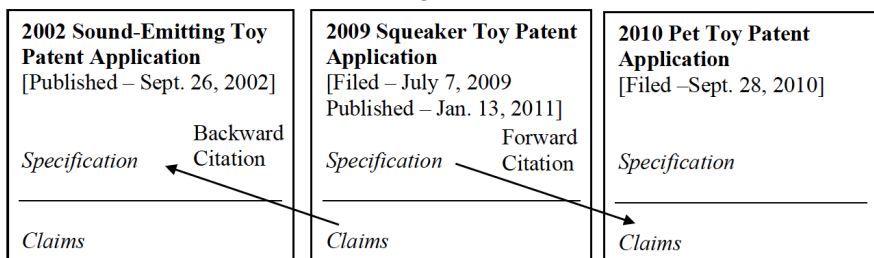
⁷⁵ The specification of a patent application (*i.e.*, the written portion of the application except for claims) identifies work done by another as prior art; the subject matter so identified is treated as admitted prior art. *In re Nomiya*, 509 F.2d 566, 571 (C.C.P.A. 1975) (holding the applicant’s labeling of two figures in the application drawings as prior art to be an admission that what was pictured was prior art relative to the applicant’s improvement).

⁷⁶ *Id.*

⁷⁷ A backward citation is a citation of a previously published document that had already been available publicly before the new patent application was filed and, as such, is deemed to be “prior art.” Xiaojun Hu et al., *On the Definition of Forward and Backward Citation Generations*, 5 J.

citation cited during prosecution, in this specific example, is the citation and use of the prior 2002 Sound-Emitting Toy Patent Application to reject some of the 2009 Squeaker Toy Patent Application's claims.⁷⁸ In contrast, there are forward citations for a given patent or published application.⁷⁹ The forward citations include citations of the patent or published application in future patent examinations,⁸⁰ such as the use of the 2009 Squeaker Toy Patent Application by an examiner to reject claims in the 2010 Pet Toy Patent Application. Figure 1, below, graphically depicts this relationship: where backward citations can involve the application of a prior patent/published application's specification to the current patent application's claim, and forward citations can involve the application of the current patent/published application's specification to a new patent application's claims.

Figure 1



Patent rights are provided only after a substantive examination with the USPTO and the payment of an issuance fee.⁸¹ When a patent issues, its

INFORMETRICS 27, 27–36 (2011) (describing the manner in which publications directly and indirectly influence others).

⁷⁸ *Id.*; see MPEP, *supra* note 27, §§ 2129, 2152.03 (discussing admissions as prior art, in which the admitted prior art anticipates the claim, but does not qualify as prior art under any of the paragraphs of 35 U.S.C. § 102; the claim may be rejected as being anticipated by the admitted prior art without citing to 35 U.S.C. § 102).

⁷⁹ Nathan Falk & Kenneth Train, *Patent Valuation with Forecasts of Forward Citations*, 12 J. BUS. VALUATION & ECON. LOSS ANALYSIS 1, 2 (2016) (“The citations that a patent receives from subsequent patents are called forward citations.”).

⁸⁰ For a given patent (or patent application), a forward citation is another patent document's citation back to that given earlier patent (from the perspective of the given patent).

[T]here is a legal dimension to patent citations, since they represent a limitation on the scope of the property rights established by a patent's claims, which carry weight in court. Equally important, the process of arriving at the final list of references, which involves the applicant and his attorney as well as the examiner, apparently does generate the right incentives to have all relevant patents cited, and only those. The presumption that citation counts are potentially informative of something like the technological importance of patents is thus well grounded.

Trajtenberg, *supra* note 15, at 174 (citation omitted).

⁸¹ 35 U.S.C. § 151.

owner obtains the right to exclude others from making, using, selling, offering to sell, and importing into the United States devices, systems, or methods that fall within the scope of an issued claim.⁸² Unless a patent issues, the owner has no rights to exclude others whatsoever.⁸³

There are different reasons that an applicant may abandon without obtaining a patent. Some reasons are pure voluntary choices by the applicant, including that the applicant no longer is interested in the underlying technology or lacks funds to proceed with patent prosecution.⁸⁴ Other reasons relate to defects in the application, such as that the USPTO initially rejected the application as being obvious. Unfortunately, the USPTO does not provide reasons for abandonment and consequently they do not appear within the USPTO records.

B. Abandoned Patent Applications as Prior Art

The prior discussion focused on the use of prior patents or published applications to reject a later patent application's claims currently under examination. Technically, these prior patents and published applications are considered prior art under 35 U.S.C. § 102 along with other published articles and prior uses and offers for sale.⁸⁵ All of these, together, are considered potential prior art that may render a patent application's claims not novel or obvious.

A hallmark of most prior art is that, to qualify as prior art and potentially render a future patent's claims unpatentable, the prior art is public.⁸⁶

⁸² *Id.* § 271. The patent holder's right to make his or her own invention is dependent upon the rights of others and whatever general laws might be applicable. Another party may own a patent that will prevent the patentee from utilizing his or her own invention.

⁸³ 35 U.S.C. § 154(d) provides provisional rights to a patent owner permitting recovery of a reasonable royalty from an infringer for periods before the patent issued in certain circumstances. *Id.* § 154(d). These provisional remedies, however, are only available if a patent eventually issues. If the application is abandoned, then no provisional rights accrue. See Charles R. Macedo, *Effect of the Publication of Applications Under the American Inventors Protection Act of 1999*, 13 FED. CIR. B.J. 627, 629 (2005).

⁸⁴ See, e.g., Austen Zuege, *Understanding Patent and Commercial Warranty Liability Stemming from Pending Patent Applications*, 18 WAKE FOREST J. BUS. & INTELL. PROP. L. 443, 447 (2018) (explaining that one reason a patent application goes abandoned is because of the "lack of a commercial market for the invention").

⁸⁵ 35 U.S.C. § 102.

⁸⁶ Robert Patino, *Intellectual Property Rights and Research Disclosure in the University Environment: Preserving the Commercialization Option and Optimizing Market Interest*, 48 J. AM. ASS'N LABORATORY ANIMAL SCI. 138, 138 (2009) ("Prior art may include previously published journal articles, issued patents, published patent applications, abstracts, and publicly available grant information, just to name a few examples. Therefore, the scope of claim protection for a patent depends on how extensively a particular technology has been studied and reported to the public.").

Issued patents and published patent applications are, by definition, publicly available to all via the USPTO.⁸⁷ The Patent Act has long classified “patents and printed publications” as key categories of prior art.⁸⁸ Printed publications include any document that is accessible to the public such that people in the field can locate it.⁸⁹ A leading opinion from the United States Court of Appeals for the Federal Circuit ruled that a “single catalogued thesis in one university library” was sufficiently accessible to constitute prior art that precluded a subsequent inventor.⁹⁰ The actual use of or offer to sell an invention can be prior art, if such activity is deemed public enough.⁹¹ There is a category of “secret” prior art, where the art is not available to the public at this earlier time, although it enjoys the earlier effective date when the art does become public.⁹²

Published patent applications, as well as other prior art defined under § 102, constitute prior art for purposes of obviousness too. Obviousness, which generally involves the combination of multiple pieces of prior art to invalidate a claimed invention, involves the same prior art as considered for

⁸⁷ The one exception is if an applicant requests non-publication at the initial filing of the non-provisional application.

⁸⁸ For patent applications with an effective filing date before March 2013, prior art for purposes of novelty was defined by 35 U.S.C. § 102(a) and 35 U.S.C. § 102(b). Both of these provisions precluded patentability of the invention if it was previously “patented or described in a printed publication.” 35 U.S.C. §§ 102(a), (b) (1952). The America Invents Act (AIA) revised the statute, 35 U.S.C. § 102, for applications with an effective filing date after March 2013, but maintained the same operative language. Pub. L. 112-29, § 3(b), 125 Stat. 284, 285–86 (amending 35 U.S.C. § 102 but retaining the language “patented, described in a printed publication”); *see also* 35 U.S.C. § 102(a) (2018) (showing the same language).

⁸⁹ MPEP, *supra* note 27, § 2128. “A reference is proven to be a ‘printed publication’ ‘upon a satisfactory showing that such document has been disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art, exercising reasonable diligence, can locate it.’” *Id.* (quoting *In re Wyer*, 655 F.2d 221, 226 (C.C.P.A. 1981) (making clear, as the section’s title reads, that “a reference is a ‘printed publication’ if it is accessible to the public”). To show that a reference is a prior art printed publication, a petitioner must demonstrate that the reference was publicly accessible before the critical date of the challenged patent. *Samsung Elecs. Co. v. Infobridge Pte. Ltd.*, 929 F.3d 1363, 1373 (Fed. Cir. 2019) (finding that the asserted reference was publicly accessible because a person of ordinary skill in the art could, through the exercise of reasonable diligence, access the reference).

⁹⁰ *In re Hall*, 781 F.2d 897, 900 (Fed. Cir. 1986) (“[W]e reject appellant’s legal argument that a single catalogued thesis in one university library does not constitute sufficient accessibility to those interested in the art exercising reasonable diligence.”).

⁹¹ 35 U.S.C. § 102(e) (1952) (noting that a U.S. patent application filed by another party is prior art, even though it was published after the invention was made by a later applicant, if the patent application was in fact filed earlier).

⁹² For a general discussion of secret prior art, see Andrew C. Michaels, *Pot Calls Kettle Dictum: Expanded Secret Prior Art in Obviousness*, 26 FED. CIR. B.J. 93, 97–103 (2016).

novelty.⁹³ The Patent Act defines obviousness with a note that the “claimed invention is not identically disclosed as set forth in section 102 [novelty].”⁹⁴

Many years of judicial decisions have tied the prior art as defined for novelty to the prior art for obviousness purposes.⁹⁵ For these reasons, the USPTO treats published patent applications as prior art for purposes of novelty and obviousness to subsequent applications.

Under longstanding patent theory and practice, patents are only awarded for “new” inventions.⁹⁶ If an invention is not new, then the patent has not provided new information to society.⁹⁷ Patents are supposed to be a bargain: rights to exclude others from making, using, selling, offering to sell, and importing, in exchange for a full and valuable disclosure.⁹⁸ If the invention is not new, the cost to society of the exclusive rights of a patent would be unwarranted.⁹⁹ The other half of the bargain would not be met because the disclosure would not be valuable; instead, it would be old information.¹⁰⁰

⁹³ 35 U.S.C. § 103 (2018). To be sure, there are doctrines, such as the analogous arts doctrine, that preclude some pieces of prior art from applicability to the obviousness determination. Jacob S. Sherkow, *Negating Invention*, 2011 BYU L. REV. 1091, 1108–10.

⁹⁴ 35 U.S.C. § 103(a).

⁹⁵ Donald S. Chisum, *Sources of Prior Art in Patent Law*, 52 WASH. L. REV. 1, 3–4 (1976). Controversially, the courts treat “secret prior art” as prior art for obviousness. See Dennis Crouch, *Does Secret Prior Art Apply to the Obviousness Analysis?*, PATENTLY-O: PAT. BLOG (Dec. 13, 2017), <https://patentlyo.com/patent/2017/12/secret-obviousness-analysis.html> [<https://perma.cc/496C-CVKW>].

⁹⁶ 35 U.S.C. § 102; Rebecca S. Eisenberg, *Patents and the Progress of Science: Exclusive Rights and Experimental Use*, 56 U. CHI. L. REV. 1017, 1022 (1989).

⁹⁷ J. Jonas Anderson, *Nontechnical Disclosure*, 69 VAND. L. REV. 1573, 1585–86 (2016) (“Disclosure theorists put the primary emphasis on disclosing new inventions and the further innovation that comes from that disclosure.”).

⁹⁸ See *Bonito Boats, Inc. v. Thunder Craft Boats, Inc.*, 489 U.S. 141, 151 (1989) (“In consideration of [the invention’s] disclosure and the consequent benefit to the community, the patent is granted.”); *Universal Oil Prods. Co. v. Globe Oil & Ref. Co.*, 322 U.S. 471, 484 (1944); Sean B. Seymore, *Making Patents Useful*, 98 MINN. L. REV. 1046, 1073–74 (2014).

⁹⁹ Anderson, *supra* note 97, at 1585 (“Therefore, according to disclosure theorists, the patent system can be justified by how much information it brings to the public that otherwise would be private.”); see also Sara Boettiger & Cecilia Chi-Ham, *Defensive Publishing and the Public Domain*, in 1 INTELLECTUAL PROPERTY MANAGEMENT IN HEALTH AND AGRICULTURAL INNOVATION: A HANDBOOK OF BEST PRACTICES 879 (Anatole Krattiger et al. eds., 2007), <http://www.iphandbook.org/handbook/resources/Publications/links/ipHandbook%20Volume%201.pdf> [<https://perma.cc/8YF2-LZ49>] (explaining that, although “[a] well-functioning innovation system strikes a balance between” protection of innovation while maintaining public access, “the exclusionary power of IP rights can also have negative effects” thereby necessitating not only an understanding of this balance, but also the use of alternative strategies, such as defensive publishing, to ensure the maintenance of such balance).

¹⁰⁰ *Integra Lifesciences I, Ltd. v. Merck KGaA*, 331 F.3d 860, 873 (Fed. Cir. 2003) (Newman, J., concurring in part and dissenting in part) (“The purpose of a patent system . . . serves to add to the body of published scientific/technologic knowledge.”), *vacated and remanded sub nom. Merck KGaA v. Integra Lifesciences I, Ltd.*, 545 U.S. 193 (2005).

The reason prior art needs to be public ties directly to patent law's bargain: rights to exclude others from making, using, selling, offering to sell, and importing, in exchange for a full and valuable disclosure.¹⁰¹ If society already has the invention—it is publicly available—gaining disclosure of the invention does not require patent rights.¹⁰² If the public already possesses the invention—it is not novel—this quid pro quo is not necessary.¹⁰³ In turn, the patent applicant, to gain patent protection, must forego trade secret protection and tell the public—via the patent itself—about the invention and how to make and use it.¹⁰⁴ Through the act of publication, trade secret protection for the invention was forgone.¹⁰⁵ If the invention is already publicly available, and thus not new, the cost to society of the exclusive rights of a patent would be unwarranted.¹⁰⁶ The other half of the bargain would not be met because the disclosure would not be valuable; instead it would be old information.¹⁰⁷ A core tenant of patent law is the quid pro quo between a limited period of exclusivity over the invention for the life of the patent in exchange for public dedication of the invention at the end of the patent term.¹⁰⁸ This is why a description of the invention in, for example, a draft of an article kept in the author's drawer is not considered publicly available, and thus not in the public's possession.¹⁰⁹ This secret draft cannot deny a future inventor patent protection because the public has yet to gain one of

¹⁰¹ See *Bonito Boats*, 489 U.S. at 151; *Universal Oil Prods.*, 322 U.S. at 484; Seymore, *supra* note 98, at 1073–74.

¹⁰² See Deepak Hegde & Hong Luo, *Patent Publication and the Market for Ideas* 25–26 (Harv. Bus. Sch., Working Paper No. 14-019, 2016), <https://ssrn.com/abstract=2293225> [<https://perma.cc/6DWH-HEZX>] (empirically evaluating whether disclosure via a formal patent publication has advantages over other voluntary disclosures by the inventor).

¹⁰³ Andrew Beckerman-Rodau, *The Choice Between Patent Protection and Trade Secret Protection: A Legal and Business Decision*, 84 J. PAT. & TRADEMARK OFF. SOC'Y 371, 380 n.86 (2002).

¹⁰⁴ *Id.*

¹⁰⁵ Daniel Gervais, *The Patent Option*, 20 N.C. J.L. & TECH. 357, 359 n.2 (2019).

¹⁰⁶ Anderson, *supra* note 97, at 1585.

¹⁰⁷ *Integra Lifesciences*, 331 F.3d at 873 (Newman, J., concurring in part and dissenting in part).

¹⁰⁸ *Brenner v. Manson*, 383 U.S. 519, 533 (1966) (stating that one goal “of the patent system is to encourage the dissemination of” technical knowledge).

¹⁰⁹ See UNIV. TENN. RESEARCH FOUND., *THE IMPACT OF PUBLIC DISCLOSURE UNDER THE AMERICA INVENTS ACT 1*, <https://utrf.tennessee.edu/wp-content/uploads/PublicDisclosure4.10.13.pdf> [<https://perma.cc/RV8C-W7P7>].

A public disclosure is information available to the public that describes an invention claimed in a US patent application. It can be in the form of an issued patent, a printed publication (including a published patent application), or anything else. An invention is also deemed to be publicly disclosed if it is “on sale” or “in public use.”

the presumed benefits of patent protection: the invention eventually falling into the public domain.¹¹⁰

This quid pro quo and mutual exclusivity between secrecy and patent protection is relevant to abandoned patent applications, because if an abandoned application is never publicly available, an examiner cannot consider it prior art and thus reject a future patent application's claims.¹¹¹ If abandoned applications are published, however, then they can be considered in future patent examinations along with other publicly available art.¹¹² The public nature of abandoned patent applications has changed over the years. The patent begins publicly available, then remains permanently secret for most applications, before eventually becoming publicly available eighteen months after application.¹¹³

Patent applications, when initially filed, were, and still are, kept secret and not open to public inspection.¹¹⁴ Typically, the only way the patent ap-

¹¹⁰ U.S. Patent & Trademark Office, PowerPoint, First Inventor to File (FITF) Comprehensive Training 4 (2013), https://www.uspto.gov/sites/default/files/aia_implementation/fitf_comprehensive_training_prior_art_under_aia.pdf [<https://perma.cc/NP4M-3D7X>] (“The availability of a disclosure as prior art under 102(a)(1) or 102(a)(2) depends upon the effective filing date of the claimed invention.” (emphasis omitted)).

¹¹¹ See MPEP, *supra* note 27, § 2152.02(a) (noting an exception for patents that are kept “secret” and stating that such a patent becomes “available as prior art as of the date the patent was made available to the public by being laid open for public inspection or disseminated in printed form”). An applicant, however, may want to expressly abandon a patent application in order to avoid publication (and retain the invention as a trade secret). See 37 C.F.R. § 1.138.

¹¹² See MPEP, *supra* note 27, § 901.02.

If an abandoned application was previously published under 35 U.S.C. [§] 122(b), that patent application publication is available as prior art under pre-AIA 35 U.S.C. [§§] 102(a) and 102(b) and 35 U.S.C. [§] 102(a)(1) as of its patent application publication date because the patent application publication is considered to be a “printed” publication within the meaning of pre-AIA 35 U.S.C. [§§] 102(a) and 102(b) and 35 U.S.C. [§] 102(a)(1), even though the patent application publication is disseminated by the U.S. Patent and Trademark Office (Office) using only electronic media.

Id.

¹¹³ Historically, applications for U.S. patents were kept secret until granted. Congress, in 1999, sought to align the United States with the vast majority of other nations by requiring publication eighteen months after first filing, which inevitably sparked disagreement among inventors claiming that “[pre-grant disclosure] will prove very damaging to American small inventors and thereby discourage the flow of new inventions that have contributed so much to America’s superior performance.” *An Open Letter to the U.S. Senate*, EAGLE FORUM, http://www.eagleforum.org/patent/nobel_letter.html [<https://perma.cc/TBF4-USS4>]; see also H.R. REP. NO. 112-169, at 18 (2011).

¹¹⁴ MPEP, *supra* note 27, § 103 (“If the published patent application is pending and it is not maintained in the [Image File Wrapper (IFW)] system, the paper application file itself will not be available to the public for inspection. Only copies of the application file may be obtained pursuant to 37 CFR 1.14(a)(1)(iii).”).

plication became public was for a patent to issue from it.¹¹⁵ Upon issuance, the patent, and the underlying application, became publicly available.¹¹⁶ In the 1800s, however, if the patent application was abandoned, the USPTO did not protect the application by “any rule of secrecy.”¹¹⁷ In fact, the working model of the invention¹¹⁸ submitted along with the now-abandoned patent application was open to general inspection by the public at the USPTO along with the abandoned patent application’s specification.¹¹⁹ Patent examiners could, and did, use the specifications and models of previous, abandoned patent applications as prior art in future patent applications as evidence that the future application’s claims were either not novel or obvious.¹²⁰ Notably, the abandoned patent applications were not published in the Patent Office Gazette, the publication in which issued patents were printed and made available to the general public across the United States.¹²¹ Abandoned patent applications, and their models, were only available at the USPTO.¹²²

The Supreme Court put an end to this practice in its decision in *Brown v. Guild*,¹²³ commonly referred to as the *Corn-Planter Patent* case. The issue before the Court in the case was whether an abandoned patent applica-

¹¹⁵ 37 C.F.R. § 1.11 (listing all files that are open to the public upon filing).

¹¹⁶ *Id.*

¹¹⁷ See Dennis Crouch, *Reviving Unintentionally Abandoned Patent Applications*, PATENTLY-O: PAT. BLOG (Feb. 25, 2008), <https://patentlyo.com/patent/2008/02/asdf-2.html> [<https://perma.cc/L3BU-CMVM>]. (“The Patent Act discusses revival for unintentional abandonment due to failure to submit proper application fees (35 USC [§] 111) and failure to rescind a nonpublication request (35 USC [§] 122). In other cases, however, the Patent Act only explicitly allows revival of unavoidably abandoned cases—a much higher standard.”).

¹¹⁸ DEBRA K. HUGHES, *ARTIFACTS OF INVENTION: PATENT MODELS AT THE HAGLEY MUSEUM AND LIBRARY* 1–3 (1993); Press Release, U.S. Patent & Trademark Office, USPTO Museum Opens New Exhibit Showcasing American Ingenuity (Feb. 11, 2002), <https://www.uspto.gov/about-us/news-updates/uspto-museum-opens-new-exhibit-showcasing-american-ingenuity> [<https://perma.cc/UR7L-AVEC>]. Models are not currently required unless requested by the Directors. See 35 U.S.C. § 114.

¹¹⁹ See P.J. Federico, *The Use of Abandoned Applications as References*, 28 J. PAT. OFF. SOC’Y 160, 161 (1946) (noting that “[t]he models in abandoned cases were so placed as to be subject to general inspection”).

¹²⁰ See KENNETH W. DOBYNS, *THE PATENT OFFICE PONY: A HISTORY OF THE EARLY PATENT OFFICE* 101 (1994) (“Models were still required, and provision was made for their public display.”); Federico, *supra* note 119, at 160–61 (“At one time the Patent Office cited abandoned applications to reject subsequently filed applications of later inventors.”).

¹²¹ See Federico, *supra* note 119, at 162 (“However, the widely disseminated Patent Office Reports prior to 1872, and the Official Gazette, publication of which was begun that year, contained indexes and also figures and claims or abstracts of issued patents; there was no such publication of abandoned applications.”).

¹²² See *id.* at 161–62.

¹²³ See generally *Brown v. Guild* (The Corn-Planter Patent), 90 U.S. (23 Wall.) 181 (1874).

tion could be used as prior art to invalidate a later filed patent.¹²⁴ The district court, following the USPTO guidelines detailed above, used the prior abandoned applications of Remy and Kelly to invalidate an applied-for patent.¹²⁵ The Supreme Court, in the *Corn-Planter Patent* case, disagreed, holding that an abandoned application is an “abandoned experiment” that is “incapable of being set up against any other claim.”¹²⁶ The Court noted that the abandoned patent application was not a “printed publication” as understood in the Patent Act of 1836, and thus, could not be considered as that type of prior art.¹²⁷ Any consideration that the abandoned application was evidence of prior invention by another was dispelled because, due to its abandonment, the withdrawn application “was only an experiment and was never perfected or brought into actual use.”¹²⁸ After the Court’s decision in the *Corn-Planter Patent* case, other courts began to reject the use of abandoned patent applications, by themselves, as prior art.¹²⁹

After this decision, the USPTO eventually changed its examination rules to forbid the usage of abandoned patent applications and their accompanying models, as follows:

Following this decision the Commissioner (now Robert Holland Duell) on February 3, 1876 ordered that the files, models and drawings relating to abandoned applications be no longer open to inspection by the general public, and that only those would be permitted to examine them who had a reason acceptable to the Office for so doing.¹³⁰

In turn, a specific USPTO rule was promulgated explicitly stating that abandoned patent applications were not to be cited as references in patent examination.¹³¹ Furthermore, after the *Corn-Planter Patent* case and subsequent USPTO rules, abandoned patent applications were no longer publicly

¹²⁴ *Id.* at 219 (“The first question to settle is, whether, as thus limited and restricted, the patent is valid, or whether the invention, as thus patented, was anticipated by prior inventions.”); *see also id.* at 210 (“Were it not for the application for a patent it would justly be regarded as an abandoned experiment, incapable of being set up against any other claim. Can the fact that such an application was made and afterwards voluntarily withdrawn, and never renewed, make any difference? We think not.”).

¹²⁵ *Id.* at 183.

¹²⁶ *Id.* at 210.

¹²⁷ *Id.* at 211 (quoting Patent Act of 1836, ch. 357, § 7, 5 Stat. 117, 119–20).

¹²⁸ *Id.* at 211.

¹²⁹ *See* Federico, *supra* note 119, at 166–71 (detailing the “half dozen decisions of lower courts” applying the *Corn-Planter Patent* case to use abandoned patents to reject applications).

¹³⁰ *Id.* at 165–66.

¹³¹ *Id.* at 166.

available and no longer used in the examination of future patent applications.¹³²

The secret nature of abandoned applications changed around 150 years later with the 1999 passage of the American Inventors Protection Act (AIPA).¹³³ Under the AIPA, a U.S. patent application automatically publishes unless it receives a proper request for non-publication.¹³⁴ This practice was put into place to bring the United States in step with the patent laws of other nations.¹³⁵ Thus, starting in 2000, nearly all U.S. patent applications were published eighteen months after filing with the USPTO.¹³⁶ Prior studies estimate that only about 5 to 7.5% of patent applications contain a non-publication request.¹³⁷ Consequently, since 2000, almost all patent applica-

¹³² *Id.*

¹³³ MPEP, *supra* note 27, § 901.03.

The American Inventors Protection Act of 1999 (AIPA) was enacted into law on November 29, 1999. The AIPA amended 35 U.S.C. [§] 122 to provide that, with certain exceptions, applications for patent filed on or after November 29, 2000 shall be published promptly after the expiration of a period of eighteen (18) months from the earliest filing date for which a benefit is sought under title 35, United States Code, and that an application may be published earlier at the request of the applicant.

Id.; see 35 U.S.C. § 122(b); 37 C.F.R. §§ 1.215, 1.219.

¹³⁴ 35 U.S.C. § 122(b)(1) (“[E]ach application for a patent shall be published, in accordance with procedures determined by the Director, promptly after the expiration of a period of 18 months from the earliest filing date for which a benefit is sought under this title.”); see also *id.* § 122(b)(2)(B)(i) (stating that an application will not be published “[i]f an applicant makes a request upon filing, certifying that the invention disclosed in the application has not and will not be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication of applications 18 months after filing”); 37 C.F.R. § 1.213.

¹³⁵ Before that time, patent applications were maintained as confidential by the USPTO. See Daniel K.N. Johnson & David Popp, *Forced Out of the Closet: The Impact of the American Inventors Protection Act on the Timing of Patent Disclosure*, 34 RAND J. ECON. 96, 96 (2003) (“Historically, information on a U.S. patent application has not been published until the patent is granted.”). One reason advanced by proponents of the new law was that “it move[d] toward international harmonization of patent law.” *Id.*

¹³⁶ 35 U.S.C. § 122(b)(1).

¹³⁷ Stuart Graham & Deepak Hegde, *Do Inventors Value Secrecy in Patenting? Evidence from the American Inventor's Protection Act of 1999*, at 5 (Working Paper, 2014), <http://ssrn.com/abstract=2170555> [<https://perma.cc/F3W9-QAGP>] (estimating that 7.5% percent of patent applications filed from 2001 to 2005 had a non-publication request); Chad Gilles, *Nonpublication Requests and Their Pitfalls (Including Making Zombies)*, BIGPATENTDATA (Mar. 4, 2019), <https://bigpatentdata.com/2019/03/nonpublication-requests-and-their-pitfalls-including-making-zombies/> [<https://perma.cc/A6VB-FYQF>] (“It seems about 5% of applications are filed with nonpublication requests.”); see also Stuart Graham & Deepak Hegde, *Disclosing Patents' Secrets*, 347 SCI. 236, 236 (2015).

tions in the United States have been published.¹³⁸ The publications of patent applications are made available to the public.¹³⁹

Given the constant backlog of patent applications, many, if not most, patent applications are not even examined by patent examiners before this eighteen-month publication.¹⁴⁰ The published applications are rarely abandoned immediately after publication, and therefore patent examiners continue to evaluate and examine these applications as detailed above in Part I.A.¹⁴¹ Publication provides no affirmative rights to the applicant, unless the patent later issues.¹⁴²

An abandoned published application occurs when, instead of issuing after publication, the patent application goes abandoned. Abandonment occurs when either the applicant expressly notifies the USPTO of his or her intent to abandon,¹⁴³ the applicant fails to respond to an office action or other USPTO action within the required statutory period,¹⁴⁴ or the applicant decides to not pay the issuance fee within a defined period.¹⁴⁵ Once a pub-

¹³⁸ Others have argued that the publication requirement did not have a significant effect on applicant behavior. See Reiko Watase, Note, *The American Inventors Protection Act of 1999: An Analysis of the New Eighteen-Month Publication Provision*, 20 CARDOZO ARTS & ENT. L.J. 649, 651 (2002) (“[T]he new publication provision of the AIPA fails to have any major impact on the U.S. patent system because of the broad exemption for applicants that do not file abroad.”).

¹³⁹ Some believed that the publication requirement would result in more knowledge diffusion. Johnson & Popp, *supra* note 135, at 97 (using U.S. patent data from 1976 to 1996 to assert that the addition of a publication requirement in the United States will result in faster knowledge diffusion). Others have argued that publication increased licensing activity. See Deepak Hegde & Hong Luo, *Patent Publication and the Market for Ideas*, 64 MGMT. SCI. 652, 670 (2018) (finding data to support the view that published patent applications are significantly more likely to be licensed before patent grant and shortly after the eighteen-month publication period).

¹⁴⁰ See Andrei Iancu, *USPTO Meets Critical Goals to Reduce Patent Examination Pendency*, U.S. DEP’T COM.: BLOG (Oct. 15, 2019), <https://www.commerce.gov/news/blog/2019/10/uspto-meets-critical-goals-reduce-patent-examination-pendency> [<https://perma.cc/E9BM-Q8GL>] (noting that first office action pendency was 14.7 months and traditional total pendency was 23.8 months); *Patents Production, Unexamined Inventory and Filings Data August 2020*, U.S. PAT. & TRADE-MARK OFF., <https://www.uspto.gov/dashboard/patents/production-unexamined-filing.html> [<https://perma.cc/2UFJ-DF27>] (detailing that the unexamined patent application inventory comprises of 572,688 applications and the RCE inventory is comprised of 21,475 applications).

¹⁴¹ See *infra* Part I.A.

¹⁴² The AIPA, 35 U.S.C. § 154(d), gives the inventor provisional rights.

¹⁴³ 37 C.F.R. § 1.138(a) (“An application may be expressly abandoned by filing a written declaration of abandonment identifying the application in the United States Patent and Trademark Office.”).

¹⁴⁴ See, e.g., *id.* § 1.135(a) (“If an applicant of a patent application fails to reply within the time period provided . . . the application will become abandoned unless an Office action indicates otherwise.”).

¹⁴⁵ *Id.* § 1.135 (detailing abandonment due to failure to reply properly within a defined time period).

lished patent application is abandoned, the applicant cannot reapply for a patent on the same invention.¹⁴⁶

Publication under the AIPA changed the status of abandoned applications as prior art.¹⁴⁷ Starting in 2000, if an abandoned application is published, it undoubtedly qualifies as prior art.¹⁴⁸ The fact that the application is abandoned is irrelevant—the public is, as of publication, in possession of the details described in the published application, even though abandoned.¹⁴⁹ Because a published patent application is accessible to the public, it clearly constitutes prior art.¹⁵⁰ Thus, published patent applications qualify as prior art.

To be sure, abandoned published applications are abandoned, by definition, meaning that the original inventor did not obtain a patent. Since 2000, however, the publication of the disclosure of the invention is available to society.¹⁵¹ If someone else invents the same thing later in time, the second inventor did not provide a new disclosure to society, and has not invented anything new. Thus, using abandoned published applications as prior art makes theoretical sense in the patent system.¹⁵²

¹⁴⁶ This is because the published application will count as disqualifying prior art to the subsequent patent application. Of course, if the applicant files a continuation application before abandonment, the applicant can rely upon the original filing date. 35 U.S.C. § 120.

¹⁴⁷ The final provisions of the AIPA became effective on November 29, 2000.

¹⁴⁸ See MPEP, *supra* note 27, § 901.02.

¹⁴⁹ See *id.* (referencing 37 C.F.R. § 1.11(a)).

¹⁵⁰ *Id.* (“Subject matter from abandoned applications which is available to the public under 37 CFR [§] 1.14 may be used as prior art against a pending U.S. application . . . as of the date the subject matter became publicly available.”).

¹⁵¹ *Id.* § 901.03 (clarifying that such availability is pursuant to 35 U.S.C. § 122(b), which provides for publication of the patent application “eighteen (18) months from the earliest filing date”).

¹⁵² Deepak Hegde et al., Patent Publication and Innovation 26 (Apr. 6, 2018), <https://ssrn.com/abstract=3158031> [<https://perma.cc/84FW-6MTN>] (concluding that the AIPA amendments reduce follow-on inventors’ R&D and patenting costs); see *Parker v. Flook*, 437 U.S. 584, 594–95 (1978); see also *Gottschalk v. Benson*, 409 U.S. 63, 65, 71–72 (1972) (illustrating the Supreme Court’s 1970s struggle with mathematical algorithm and software patents, shifting from a refusal to allow mathematical algorithm patents and later holding both that a process could be patented and that software must be tied to a particular machine to achieve patentability). The 1980s and 1990s led to further erosion of this software patentability requirement, until finally in 1990, in *State Street Bank & Trust Co. v. Signature Financial Group, Inc.*, the Federal Circuit eliminated any such requirement, holding that both software alone and business methods were patentable regardless of the form in which they were implemented, if the invention produced a “useful, concrete and tangible result.” 149 F.3d 1368, 1373 (Fed. Cir. 1998) (quoting *In re Alappat*, 33 F.3d 1526, 1544 (Fed. Cir. 1994) (en banc)), *abrogated In re Bilski*, 545 F.3d 943, 959 (Fed. Cir. 2008) (en banc). The patentability of software is now governed by the Supreme Court standard recited in *Alice Corporation Proprietary Ltd. v. CLS Bank International*. 573 U.S. 208, 217–22 (2014) (inquiring whether claims are directed to an abstract idea, and if so, whether claims add an “inventive concept”).

Although it is not important to this Article's methodology or findings, it is useful to keep in mind that the America Invents Act (AIA), signed into law in 2011, altered the novelty requirement in patent law. The AIA changed the United States from a system where the first inventor was entitled to the patent (subject to some limitations), to a system where the first filer of a patent application was entitled to a patent (subject to some limitations).¹⁵³ Under both the pre- and post-AIA change, published patent applications clearly were prior art to subsequent inventions. Moreover, published patent applications are prior art for another reason. There is a special section of the Patent Act relating to novelty geared only to issued patents and published patent applications.¹⁵⁴ The pre-AIA section 102(e) and post-AIA section 102(d) permit the use of published applications as of their filing dates, rather than the date they are made publicly available. The same sections permit the use of issued patents as of their filing dates too.

C. Presumed Lack of Value or Benefit of Abandoned Applications

Now that abandoned published patent applications can be prior art and are open to evaluation, we should revisit and reconsider whether they are valuable. The academic literature says very little about the value of abandoned patents.¹⁵⁵ We use the term "value" not in its pure economic sense of how much a consumer would pay for the good. Instead, by value we mean to capture the benefit to the applicant and to the patent system more broadly.

Private value or benefit, the value to the inventor or assignee,¹⁵⁶ is assumed to be zero after the application has been abandoned. Public value, the value to society,¹⁵⁷ is also assumed to be zero because most scholars dis-

¹⁵³ David S. Abrams & R. Polk Wagner, *Poisoning the Next Apple? The America Invents Act and Individual Inventors*, 65 STAN. L. REV. 517, 519–20 (2013).

¹⁵⁴ The pre-AIA code included 35 U.S.C. § 102(e). That section included as prior art disclosures in "an application for patent, published under [35 U.S.C. §] 122(b)." The post-AIA code includes an analogous provision: 35 U.S.C. § 102(d).

¹⁵⁵ In fact, most academic literature discussing value focuses on issued patents and the breadth of their claims. See Edmund W. Kitch, *Property Rights in Inventions, Writings, and Marks*, 13 HARV. J.L. & PUB. POL'Y 119, 122–23 (1990) (concluding that most patents are so narrow that they are relatively worthless).

¹⁵⁶ WILLIAM M. LANDES & RICHARD A. POSNER, *THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW* 407–09 (2003).

¹⁵⁷ See Mark A. Lemley, Essay, *Rational Ignorance at the Patent Office*, 95 NW. U. L. REV. 1495, 1503–04 (2001) (showing that many issued patents are abandoned, presumably because of their weak economic prospects); Robert P. Merges, *As Many as Six Impossible Patents Before Breakfast: Property Rights for Business Concepts and Patent System Reform*, 14 BERKELEY TECH. L.J. 577, 603 (1999) (concluding that most patented technologies will fail commercially and/or present few economic advantages); see also Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, in NAT'L BUREAU OF ECON. RESEARCH, *THE RATE AND*

count the value of the disclosure in patent applications. Subsections 1 and 2 of this Section set forth the justification for the assumption that both the private and public value of abandoned patent applications is negligible.

1. Lack of Value to Patent Applicant

The claim that the private value of abandoned patent applications is zero is straightforward. Abandoned patent applications provide no affirmative rights to the inventor.¹⁵⁸ Unlike issued patents, abandoned applications cannot be enforced.¹⁵⁹ They provide no right to exclude others from making, using, selling, offering to sell, or import the underlying invention. Not only do abandoned patent applications provide no affirmative rights, the act of publication of the disclosure serves to forfeit trade secret rights.¹⁶⁰ If any aspect of the invention that was disclosed in the application had been protected as a trade secret, it cannot be protected upon publication of the application.¹⁶¹ Upon publication, the information becomes readily ascertainable, thereby destroying any trade secret protection that existed.¹⁶²

DIRECTION OF INVENTIVE ACTIVITY: ECONOMIC AND SOCIAL FACTORS 615 (1962) (citing the Arrow Information Paradox, which illustrates that the value of information for the buyer is “not known until he has the information”).

¹⁵⁸ The Patent Act defines the exclusionary rights of a patent holder that are included within direct infringement of a patent. That definition makes clear that the exclusionary rights are limited to issued patents. 35 U.S.C. § 271(a) (“[W]hoever without authority makes, uses, offers to sell, or sells any *patented* invention, within the United States or imports into the United States any *patented* invention *during the term of the patent* therefor, infringes the patent.” (emphasis added)).

¹⁵⁹ There are limited provisional patent rights for published applications that permit a patent holder, in theory, to recover damages from the date of publication. *Id.* § 154(d). Those provisional rights, however, only accrue to published applications that are eventually granted—not to abandoned applications. *Id.* (“[A] *patent* shall include the right to obtain a reasonable royalty from any person who, during the period beginning on the date of publication of the application for such patent . . . and ending on the date the patent is issued” (emphasis added)).

¹⁶⁰ See Beckerman-Rodau, *supra* note 103, at 380 n.86.

¹⁶¹ See Andrew Beckerman-Rodau, *Prior Restraints and Intellectual Property: The Clash Between Intellectual Property and the First Amendment from an Economic Perspective*, 12 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 1, 60 n.319 (2001) (“Cessation of secrecy destroys the trade secret property in the same manner that a fire destroys a house.”).

¹⁶² Almost all the states have adopted a variation of the Uniform Trade Secrets Act (UTSA). See *Trade Secrets Act*, UNIF. LAW COMM’N, <https://www.uniformlaws.org/committees/community-home?CommunityKey=3a2538fb-e030-4e2d-a9e2-90373dc05792> (last visited Oct. 25, 2020) (showing that all states except North Carolina and New York have adopted some form of this uniform act). The UTSA requires a trade secret to “not be[] readily ascertainable.” UNIF. TRADE SECRETS ACT § 1(4)(i) (UNIF. LAW COMM’N 1978, amended 1985). Similarly, the 2016 federal Defend Trade Secrets Act includes a requirement that trade secrets not be readily ascertainable. See 18 U.S.C. § 1839(3)(B) (2018) (defining the term “trade secret” as information “not . . . readily ascertainable.”); Michael Risch, *Why Do We Have Trade Secrets?*, 11 MARQ. INTELL. PROP. L. REV. 1, 54 (2007) (noting that the “not readily ascertainable” requirement “is part of the definition of a trade secret in most states”).

Some have claimed that patent applications can be analogized to options.¹⁶³ Under this view, an inventor does not know whether an invention will be valuable at the time of filing her patent application.¹⁶⁴ The inventor therefore takes out an option by filing a patent application.¹⁶⁵ The applicant knows that some of the patent applications that she files will be valuable, but others will not.¹⁶⁶ The option provides the inventor with the opportunity to monetize the invention.¹⁶⁷ None of this, however, is inconsistent with the view that abandoned patent applications are worthless. Abandoned patent applications may be considered as options that finished “out of the money.”¹⁶⁸ The applicant elected to not pursue the option, and instead permitted the option to lapse.¹⁶⁹ Alternatively, applicants may view a pending application as a valuable signal to the market.¹⁷⁰ The applicant can advertise that the underlying technology is “patent pending.” Once the application is abandoned, however, the term “patent pending” can no longer be used.¹⁷¹ Publication also

¹⁶³ See, e.g., Christopher A. Cotropia, *Describing Patents as Real Options*, 34 J. CORP. L. 1127 (2009); see also F. Russell Denton & Paul J. Heald, *Random Walks, Non-Cooperative Games, and the Complex Mathematics of Patent Pricing*, 55 RUTGERS L. REV. 1175, 1180 (2003); Jerry A. Hausman et al., *Patent Damages and Real Options: How Judicial Characterization of Noninfringing Alternatives Reduces Incentives to Innovate*, 22 BERKELEY TECH. L.J. 825, 841–45 (2007). Others have conceptualized issued patents as merely probabilistic rights because there is no guarantee that the court will later uphold the patent. See Mark A. Lemley & Carl Shapiro, *Probabilistic Patents*, 19 J. ECON. PERSP. 75, 75–76 (2005). One could extend this theory to patent applications, which would result in the same analysis as the patents-as-options literature.

¹⁶⁴ The uncertainty regarding the value of patents has also been analogized to a lottery. See Jonathan A. Barney, *A Study of Patent Mortality Rates: Using Statistical Survival Analysis to Rate and Value Patent Assets*, 30 AIPLA Q.J. 317, 328 n.30 (2002) (“A patent is not unlike an expensive lottery ticket; you pay your money up front and hope for the big payoff.”).

¹⁶⁵ Cotropia, *supra* note 163, at 1134–36 (describing that the patent option price is based upon the costs associated with filing a patent application).

¹⁶⁶ *Id.* at 1142–43 (describing how the patenting process itself can be viewed as a series of options where the applicant must choose whether to continue with prosecution or abandonment).

¹⁶⁷ *Id.* at 1128 (“A patent is like a real option, economists say, because it allows its owner to choose between exclusively commercializing the patented invention sometime during the patent term or foregoing commercialization altogether.”).

¹⁶⁸ See Andrew M. Pardieck, *Kegs, Crude, and Commodities Law: On Why It Is Time to Reexamine the Suitability Doctrine*, 7 NEV. L.J. 301, 343 n.280 (2007) (explaining an “out of the money” option (quoting NYMEX GLOSSARY, <http://www.nymex.com>, now NYMEX RULEBOOK ch. 300.03(D)–(E), <https://www.cmegroup.com/content/dam/cmegroup/rulebook/NYMEX/3/300.pdf> [<https://perma.cc/2WNE-Y3ZJ>])).

¹⁶⁹ Cotropia, *supra* note 163, at 1129 (noting that, at some point, the patent option expires and “becomes valueless”).

¹⁷⁰ Clarisa Long famously analogized patents to serving as signals of innovation. See Clarisa Long, *Patent Signals*, 69 U. CHI. L. REV. 625 (2002). A similar claim can perhaps be made of patent applications.

¹⁷¹ 35 U.S.C. § 292(a) (“Whoever marks upon, or affixes to, or uses in advertising in connection with any article, the words ‘patent applied for,’ ‘patent pending,’ . . . when no application for

may increase the opportunity for licensing, at least until the application is abandoned.¹⁷² These examples all show that there may be benefits to applicants of having pending applications, but none of these benefits to the applicant remain after abandonment.

There is also literature on defensive patenting.¹⁷³ The gist of this literature is that some companies seek to patent to create a freedom to operate for themselves rather than to exclude others. These companies use their patents to either cross-license competitors or scare others off from enforcing.¹⁷⁴ Of course, defense patenting requires successful patenting in the first instance, not abandonment. In the past, there was a mechanism for inventors to formally disclose inventions to the USPTO without seeking a patent.¹⁷⁵ Presumably this was done for defensive purposes. This program, however, was repealed in 2011 because of its rare use and unpopularity.¹⁷⁶

There is an important strand of empirical literature that assumes that the private value of abandoned patents is small.¹⁷⁷ Then-Professor and now-Federal Circuit Judge Kimberly Moore wrote a seminal article entitled *Worthless Patents*.¹⁷⁸ That article analyzes the characteristics of issued patents that have been permitted to lapse, which account for over fifty percent of all patents.¹⁷⁹ These are patents in which the post-issuance maintenance fees were not paid.¹⁸⁰ Thus, economically rational patent owners must have

patent has been made, or if made, *is not pending* . . . [s]hall be fined not more than \$500 for every such offense.” (emphasis added)).

¹⁷² Hegde & Luo, *supra* note 102, at 4 (arguing that the AIPA provides a viable option of licensing after patent publication). Others have argued that venture capitalists use the number of applications as a proxy for good management. Lemley, *supra* note 157, at 1505–06 (“Venture capitalists use client patents (or more likely, patent applications) as evidence that the company is well managed . . .”).

¹⁷³ For a nice discussion of this literature, see Colleen V. Chien, *Opening the Patent System: Diffusionary Levers in Patent Law*, 89 S. CAL. L. REV. 793 (2016).

¹⁷⁴ See Carl Shapiro, *Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting*, in 1 INNOVATION POLICY AND THE ECONOMY 119, 119–20 (Adam B. Jaffe et al. eds., 2001).

¹⁷⁵ Originally this program was called the Defensive Publication Program. See MPEP, *supra* note 27, § 711.06. It was replaced in 1999 with Statutory Invention Registration. See Statutory Invention Registration, 64 Fed. Reg. 66,170, 66,170 (Nov. 24, 1999).

¹⁷⁶ Jim Pravel, *US Patent and Trademark Office (USPTO) Repeals Statutory Invention Registration (SIR)*, INTELLA IP (Mar. 14, 2013), <https://intella-ip.com/us-patent-and-trademark-office-repeals-statutory-invention-registration/> [<https://perma.cc/6XTD-WPVF>]; see Chien, *supra* note 173, at 850 (calling the programs “unpopular”).

¹⁷⁷ Justus Baron & Henry Delcamp, *The Private and Social Value of Patents in Discrete and Cumulative Innovation*, 90 SCIENTOMETRICS 581, 588 (2011).

¹⁷⁸ See generally Moore, *supra* note 4.

¹⁷⁹ *Id.* at 1525–26.

¹⁸⁰ Judge Moore was not alone in assuming that renewal fees discourage or weed out low value patents. See Marc Baudry & Béatrice Dumont, *Patent Renewals as Options: Improving the Mechanism for Weeding Out Lousy Patents*, 28 REV. INDUS. ORG. 41, 43 (2006) (noting “how the

concluded that the patents were worth less than the few thousand dollar costs to maintain the patents. Judge Moore assumed that the reason a patent holder chose not to pay the maintenance fee was because the patent was not as valuable as the fee.¹⁸¹ Judge Moore found that patents with more claims and more forward citations were less likely to lapse.¹⁸² Other researchers conducted empirical studies using this same framework.¹⁸³ A significant amount of literature has relied upon Judge Moore's assumptions and findings, namely to conclude that lapsed patents were worthless, and that a large percentage of patents lapsed.¹⁸⁴

Of course, lapsed issued patents were potentially valuable while they were in force. They may have been slightly valuable to their owner, though lower than the cost of the maintenance fee due to the USPTO.¹⁸⁵ It is clear that the private value of lapsed issued patents after lapsing is zero. Abandoned patent applications are like lapsed patents. After they are abandoned, they provide no value to their owner. Unlike lapsed patents, abandoned applications never, even temporarily, provided any right exclusive to their owner.

2. Negligible Disclosure Value

What about the public value of abandoned patent applications? The patent system encourages inventors to create new inventions and disclose them to the public by providing the inventors with finite exclusive rights.¹⁸⁶

profile of renewal fees can be adjusted to reduce applications from essentially worthless patents while affecting those patents that are renewed until the statutory term limit to patent protection or close to that date as little as possible").

¹⁸¹ Moore, *supra* note 4, at 1524.

¹⁸² *Id.* at 1531–32.

¹⁸³ James Bessen, *The Value of U.S. Patents by Owner and Patent Characteristics*, 37 RES. POL'Y 932, 940 (2008).

¹⁸⁴ See, e.g., Emily Michiko Morris, *The Irrelevance of Nanotechnology Patents*, 49 CONN. L. REV. 499, 549 (2016) ("Professor Kimberly Moore's study of patent-renewal rates and maintenance-fee payments provides corroborative evidence, documenting that early-stage patents are more likely to lapse for nonpayment of maintenance fees where the underlying technologies' development costs are high and where private industry has shown little interest in the technologies."); see also Francesca Cornelli & Mark Schankerman, *Patent Renewals and R&D Incentives*, 30 RAND J. ECON. 197, 208 (1999) (finding that "renewal fees should rise much more with patent length than existing fee schedules"); Jonathan S. Masur, *Costly Screens and Patent Examination*, 2 J. LEGAL ANALYSIS 687, 701 n.27 (2010) (noting that studies show "the large number of low-value patents").

¹⁸⁵ There are three discrete time periods when maintenance fees are due on issued U.S. patents. One maintenance fee is due approximately four years after issuance, another approximately eight years after issuance, and a final one approximately twelve years from issuance. 35 U.S.C. § 41(b) (detailing maintenance fee schedule).

¹⁸⁶ See *eBay Inc. v. MercExchange, L.L.C.*, 547 U.S. 388, 394 (2006) (initiating the trend to reduce patent rights through the institution of a "four-factor test" for eligibility of an injunction, 35

The exclusive rights provided by a patent are in exchange for a disclosure of the invention.¹⁸⁷ This trade, exclusive rights for disclosure and potential abandonment of trade secret protection, is known as the patent bargain.¹⁸⁸ Basically, patent laws encourage the disclosure with the enticement of exclusive rights.¹⁸⁹

Publication of patent applications complicates this bargain. The disclosure in a published application is available to the public before patent rights are awarded to the owner.¹⁹⁰ For this period of time, the public can use them, subject to certain limitations. Once a patent issues, then others cannot make, use, sell, offer to sell, or import anything claimed by the patent. The information becomes part of the public domain when the issued patent expires. The disclosure can be thought of as a public good.¹⁹¹ As previously noted, however, not all patent applications issue as patents. If a patent does not issue, then the publication is never removed from the public domain,

U.S.C. § 283, to protect the exclusive right in a patent, with an implied emphasis on practicing the invention).

When a patent is granted and the information contained in it is circulated to the general public and those especially skilled in the trade, such additions to the general store of knowledge are of such importance to the public weal that the Federal Government is willing to pay the high price of . . . exclusive use for its disclosure, which . . . will stimulate ideas and the eventual development of further significant advances in the art.

Kewanee Oil Co. v. Bicron Corp., 416 U.S. 470, 481 (1974); see S. Scott Pershern, Comment, *Taking Inventors' Lunch Money: Provide Incentives for Sensitive Technology Research Under the Patriot Act*, 29 HOUS. J. INT'L L. 697, 701–02, 706 (2007).

¹⁸⁷ See *Diamond v. Chakrabarty*, 447 U.S. 303, 307 (1980); see also *Graham v. John Deere Co.*, 383 U.S. 1, 6 (1966) (“Innovation, advancement, and things which add to the sum of useful knowledge are inherent requisites in a patent system which by constitutional command must ‘promote the Progress of . . . useful Arts.’ This is the *standard* expressed in the Constitution and it may not be ignored.” (quoting U.S. CONST. art. I, § 8, cl. 8)).

¹⁸⁸ Beckerman-Rodau, *supra* note 103, at 394; Rochelle Cooper Dreyfuss, Essay, *Trade Secrets: How Well Should We Be Allowed to Hide Them? The Economic Espionage Act of 1996*, 9 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 1, 1–2 (1998).

¹⁸⁹ Dreyfuss, *supra* note 188, at 1–2; Lisa Larrimore Ouellette, *Do Patents Disclose Useful Information?*, 25 HARV. J.L. & TECH. 545, 547 (2012) (describing the defense of disclosure theory as “call[ing] for invigorated disclosure”).

¹⁹⁰ As previously discussed, patent applications are published eighteen months from filing. The average pendency of patent prosecution was thirty months or longer between 2005 and 2015. Dennis Crouch, *Median Patent Prosecution Pendency*, PATENTLY-O: PAT. BLOG (June 15, 2015), <https://patentlyo.com/patent/2015/06/patent-prosecution-pendency.html> [<https://perma.cc/W3ZC-YVQW>].

¹⁹¹ See Sean B. Seymore, *The Teaching Function of Patents*, 85 NOTRE DAME L. REV. 621, 621 (2010) (patents are deemed public goods in that the “disclosure of the invention brings new ideas and technologies to the public and induces inventive activity”); see also *Kewanee Oil*, 416 U.S. at 481 (stating that a patent’s addition of knowledge is important to the public good).

and the public can use the information disclosed in the patent application without fear of liability to the applicant.¹⁹²

Scholars have debated the quality and importance of patent disclosure.¹⁹³ The law requires that patent applicants disclose the invention sufficient for a person of skill in the field to make and use it without undue experimentation.¹⁹⁴ The disclosure must be contained within the originally filed patent application, including the figures and the detailed description of the invention.¹⁹⁵

Many scholars have doubted whether the patent disclosure provides any technical teaching component at all. Jeanne Fromer argues that patent disclosure is ineffective because it is written in a confusing amalgamation of technical and legal jargon.¹⁹⁶ Fromer asserts that patent disclosures convey little useful information because they often contain verbiage that is difficult for engineers to understand.¹⁹⁷ Sean B. Seymore makes a similar argument, arguing that patents are shrouded with jargon and formalism of “patentese,” which obscure the invention for those seeking to learn from the disclosure.¹⁹⁸ Numerous other scholars, including Michael Abramowicz, Dan Burk, Colleen Chien, Tim Holbrook, Douglas Lichtman, Jason Rantanen, Benjamin Roin, Katherine Strandburg, and Peter Yu, have questioned the value of patent disclosure.¹⁹⁹ Other scholars have argued for different ways to conceptualize

¹⁹² *Bonito Boats*, 489 U.S. at 148 (“Once an inventor has decided to lift the veil of secrecy from his [or her] work, he [or she] must choose the protection of a federal patent or the dedication of his [or her] idea to the public at large.”); *De Graffenried v. United States*, 20 Cl. Ct. 458, 469 n.8 (1990) (“Any invention described in a printed publication more than one year prior to the date of a patent application is prior art under Section 102(b), even if the printed publication was authored by the patent applicant.”).

¹⁹³ Alan Devlin, *The Misunderstood Function of Disclosure in Patent Law*, 23 HARV. J.L. & TECH. 401, 402–03 (2010).

¹⁹⁴ 35 U.S.C. § 112(a) (“The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains . . . to make and use the same . . .”).

¹⁹⁵ To be sure, the USPTO prevents applicants from adding new material to their previously filed patent applications. *See id.* § 132 (“No amendment shall introduce new matter into the disclosure of the invention.”). If any new matter is added to an application, a new application is required, and the applicant is not entitled to rely upon the original filing date for purposes of patent examination. *Id.*

¹⁹⁶ Jeanne C. Fromer, *Patent Disclosure*, 94 IOWA L. REV. 539, 564 (2009).

¹⁹⁷ *Id.*

¹⁹⁸ Seymore, *supra* note 191, at 633–34; *see also* Sean B. Seymore, *Uninformative Patents*, 55 HOUS. L. REV. 377, 398–99 (2017) (stating that disclosure fails to stimulate ideas and promote technological progress because the law requires only minimal disclosure from the inventor).

¹⁹⁹ *See, e.g.*, Michael Abramowicz, *The Uneasy Case for Patent Races Over Auctions*, 60 STAN. L. REV. 803, 839 n.140 (2007) (suggesting that the extent to which patent documents successfully teach the inner workings of cutting-edge technologies is quite limited); Dan L. Burk, *Patent Silences*, 69 VAND. L. REV. 1603, 1606 (2016) (“[F]ar from focusing on enhanced disclosure, we should recognize that much of the critical work of the patent system can and should occur

the patent disclosure functions.²⁰⁰ Several scholars have recently studied the diffusion of knowledge among scientists by patents and failed to find significant benefits to disclosure.²⁰¹

in the open rhetorical spaces where patents are silent.”); Janet Freilich, *Prophetic Patents*, 53 U.C. DAVIS L. REV. 663, 726 (2019) (arguing that disclosures of prophetic examples in patents often mislead scientists); Jeanne C. Fromer, *Dynamic Patent Disclosure*, 69 VAND. L. REV. 1715, 1715–16 (2016) (positing that the state of patent disclosure is “impoverished” because disclosure occurs too early in the process of innovation, namely at filing, which is often before refinement, prototyping, market research, etc.); Timothy R. Holbrook, *Possession in Patent Law*, 59 S.M.U. L. REV. 123, 133–35 (2006) (advocating that the set of non-self-disclosing inventions is small compared to those that self-disclose and thus the focus of the patent system should be on incentive to innovate, not disclosure); Douglas Lichtman, *How the Law Responds to Self-Help*, 1 J.L. ECON. & POL’Y 215, 255 (2005) (noting that disclosure is “rarely revealing”); Fritz Machlup & Edith Penrose, *The Patent Controversy in the Nineteenth Century*, 10 J. ECON. HIST. 1, 26–28 (1950) (detailing early debates about the value of the patent disclosure); Kristen Osenga, *Cooperative Patent Prosecution: Viewing Patents Through a Pragmatic Lens*, 85 ST. JOHN’S L. REV. 115, 175 (2011) (advocating ways to make patent disclosure more robust); Katherine J. Strandburg, *What Does the Public Get? Experimental Use and the Patent Bargain*, 2004 WIS. L. REV. 81, 105, 111, 119 (advocating that disclosure is irrelevant for self-disclosing inventions and arguing further that these inventions came about because of the patent incentive); Peter K. Yu, *The International Enclosure Movement*, 82 IND. L.J. 827, 847 (2007) (suggesting that patent disclosures are frequently too cryptic); Note, *The Disclosure Function of the Patent System (or Lack Thereof)*, 118 HARV. L. REV. 2007, 2007 (2005) [hereinafter *Disclosure Function*] (arguing that “patent disclosures fail to convey useful information”).

When courts and commentators analyze the social benefits of patent disclosure, they typically assume that the patent system actually disseminates the information contained in patents. At least one study, however, found that patent disclosures have almost no impact on the flow of information between firms in the U.S. Another showed that U.S. firms most often use sources other than patent disclosures to learn about the most recent technological advances in their industry.

Disclosure Function, *supra*, at 2013–14 (footnotes omitted).

²⁰⁰ See, e.g., Colleen V. Chien, *Contextualizing Patent Disclosure*, 69 VAND. L. REV. 1849, 1867–69 (2016) (arguing that patent disclosure should be viewed beyond disclosures in the patent document itself, such as licensing and commercialization); Devlin, *supra* note 193, at 405 (arguing that disclosure is not a primary purpose of the patent system and should be viewed as a mere “by-product”).

²⁰¹ See, e.g., Stefano H. Baruffaldi & Markus Simeth, *Patents and Knowledge Diffusion: The Effect of Early Disclosure*, 49 RES. POL’Y 1, 2 (2020) (questioning whether information disclosed in patents is used as an input in new inventive activities); Bhaven Sampat & Heidi L. Williams, *How Do Patents Affect Follow-on Innovation? Evidence from the Human Genome*, 109 AM. ECON. REV. 203, 206 (2019) (finding that gene patents have no quantitatively significant effect on innovation). But see Jeffrey L. Furman et al., *Disclosure and Subsequent Innovation: Evidence from the Patent Depository Library Program*, at i (Nat’l Bureau of Econ. Research, Working Paper No. 24660, 2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3189955 [<https://perma.cc/CSQ5-GBYB>] (arguing that the opening of new patent libraries in the United States boosted local patenting activity, and that the data “suggest[s] that the disclosure of technical information in the patent documents is the mechanism underlying this boost in patenting”); Tim Martens, *The Disclosure Function of the U.S. Patent System: Evidence from the PTDL Program and Extreme Snowfall 4* (Apr. 19, 2019) (unpublished manuscript), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3347868 [<https://perma.cc/V56Q-GP64>] (finding that there is a “pos-

Scholars have claimed that many scientific researchers ignore patents, rendering the disclosure portion of the patent bargain illusory. Mark Lemley argued that researchers, especially in the semiconductor, telecommunications, and software fields, make conscious decisions to avoid reading the patents of others.²⁰² Lemley stated that “both researchers and companies in component industries simply ignore patents. Virtually everyone does it. They do it at all stages of endeavor. Companies and lawyers tell engineers not to read patents in starting their research”²⁰³ For instance, Intel has publicly stated that its policy forbids Intel employees from reading patents of others.²⁰⁴ Lemley asserted several reasons for this, including that reading patents could give rise to a later finding of willful infringement and triple damages.²⁰⁵ Lemley posited that ignoring patents by researchers may be beneficial in that reading patents would delay development of new products.²⁰⁶ Consistent with the view that researchers ignore the patents of others, empirical evidence demonstrates that patent examiners rarely use applicant-submitted art in their rejections to narrow patents, implying that applicant-submitted art was unimportant.²⁰⁷

Other scholars debate the view that researchers ignore patents, and counter that some researchers find patent disclosure useful. Lisa Ouellette surveyed researchers in the nanotechnology field to investigate whether they read patents.²⁰⁸ She received responses from over two hundred researchers.²⁰⁹ She found that sixty-four percent of nanotechnology respond-

itive association between local patent information availability and local trading volume of [stocks]” and further that the “association breaks down on days with extreme snowfall”).

²⁰² Lemley, *supra* note 9, at 21 (popularizing the idea that no one reads patents and third parties are deliberately ignorant of prior art).

²⁰³ *Id.*

²⁰⁴ Order Denying in Part and Granting in Part Intel Corporation’s Motion to Dismiss Claims for Direct and Indirect Infringement and Enhanced Damages Based on Willful Infringement Under Federal Rule of Civil Procedure 12(b)(6) at 1, VLSI Tech., LLC v. Intel Corp., Nos. 6:19-CV-000254-ADA, 6:19-CV-000255-ADA, Nos. 6:19-CV-000256-ADA (W.D. Tex. Aug. 6, 2019) (“The Court finds that Intel’s policy that forbids its employees from reading patents held by outside companies or individuals is insufficient to meet the test of willful blindness.”).

²⁰⁵ Lemley, *supra* note 9, at 21 (“Companies and lawyers tell engineers not to read patents in starting their research, lest their knowledge of the patent disadvantage the company by making it a willful infringer.”).

²⁰⁶ *Id.* at 25 (asserting that, if researchers read patents, then “both research and the manufacture of products would be regularly delayed for years and perhaps decades as potential defendants identified and cleared rights”).

²⁰⁷ Christopher A. Cotropia, Mark A. Lemley & Bhaven Sampat, *Do Applicant Patent Citations Matter?*, 42 RES. POL’Y 844, 850–51 (2013).

²⁰⁸ Ouellette, *supra* note 189, at 547.

²⁰⁹ Ouellette identified nanotechnology researchers by finding the corresponding authors on high impact nanotechnology journals or on corporate nanotechnology websites. *Id.* at 568.

ents had “read at least part of a patent . . . for a research purpose.”²¹⁰ From her data, she concluded that patents did provide useful information to nanotechnology researchers.²¹¹ In a later article, Ouellette expanded her research into a variety of other fields.²¹² Her later survey received responses from almost 850 researchers.²¹³ That study found evidence that about three-quarters of researchers in these fields read patents, and the majority of those researchers reported that they found useful scientific information in the most recent patent they had read in their field.²¹⁴ Some researchers, however, offered complaints regarding the readability of patents.²¹⁵

In sum, the bulk of the current literature portrays abandoned patent applications as worthless. They are privately worthless because the applicant obtained no legal rights. Further, the majority view on public value maintains that all patents, including abandoned applications, provide no useful disclosure. These conclusions stem from most academic scholars’ doubts in the effectiveness of the current patent disclosure system. They doubt researchers read patents and believe that the prior art submitted to the patent office by applicants is of little value. Although the minority position is that the disclosure in patents has some value, there is no literature whatsoever on the public value of the disclosure specifically in abandoned applications. As discussed below, our empirical findings reveal an unrecognized public, and potentially private, value in abandoned published patent applications. The USPTO often uses abandoned applications as prior art when examining future patent applications. Abandoned applications thus generate an administrative disclosure that prevents the issuance of broader patent rights to other applicants. By narrowing the scope of new patents, abandoned applications perform a public service in opening up more invention space to the public but do so at an enormous private cost to the abandonee—benefits and costs that have yet to be fully accounted for in the literature.

²¹⁰ *Id.* at 570, 602–03 tbl.1 (reporting the results of the author’s study in which “135 respondents (64%) have read at least part of a patent (other than their own) for a research purpose”).

²¹¹ *Id.* at 547 (“I find that even for [nanotechnology] researchers, patents contain useful, non-duplicative technical information . . .”).

²¹² Lisa Larrimore Ouellette, *Who Reads Patents?*, 35 NATURE BIOTECH. 421, 421, 423 (2017) (distinguishing that biotechnology and chemistry researchers generally look to the patent literature as a source of technical information more than researchers in other disciplines, though few researchers are deterred by concerns surrounding enhanced legal liability).

²¹³ *Id.* at 421 (“The survey yielded 832 respondents: 694 corresponding authors and 138 additional industry respondents . . .”).

²¹⁴ *Id.* (“Overall, 60% of all patent readers and 72% of those reading for scientific reasons reported that they found useful scientific information in the most recent patent read in their field.”).

²¹⁵ *Id.* Some researchers found the patents “vague,” “barely readable,” and “deliberately written in a manner that makes it very hard work to find what you’re looking for.” *Id.* at 423.

II. EMPIRICAL STUDY ON THE VALUE OF ABANDONED APPLICATIONS

Section A of this Part outlines how we collected and refined the data used in our study.²¹⁶ Section B provides the study results.²¹⁷

A. Study Design

We used the rejection and citation information from the USPTO Office Action Dataset from 2008 to 2017.²¹⁸ This dataset identifies rejections in office actions issued for patent applications filed over this time period,²¹⁹ as well as all citations in those applications.²²⁰ For each office action, the dataset provides the following: every patent number used in the rejection, the party citing it, the applicant or the examiner, and whether it was used in a § 102 or § 103 rejection.²²¹

We focused on comparing abandoned patent applications to issued patents because patent citation analysis is commonly done on an issued patent-by-issued patent basis.²²² Even recent scholarship of ours takes this approach.²²³ Many issued patents, and related published applications, may contain the same disclosure because they are in the same family.²²⁴ Thus, citation to any one of these is, arguably, the same as the citation to other family members and published applications. Accordingly, these citations should be collapsed in any comparative analysis to other citations. One recent study asserts that it is preferable to combine published applications and issued patents (but not other related patents) in a citation study.²²⁵ Building on that work, we are also working on combining all patent-related documents within a patent family, particularly focusing on published patent applications—abandoned or not—and how examiners use these published pa-

²¹⁶ See *infra* Part II.A.

²¹⁷ See *infra* Part II.B.

²¹⁸ Qiang Lu et al., *USPTO Patent Prosecution Research Data: Unlocking Office Action Traits 2* (U.S. Patent & Trademark Office, Working Paper No. 2017-10, 2017), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3024621 [<https://perma.cc/MT23-BNMF>].

²¹⁹ *Id.* at 2–3.

²²⁰ *Id.* at 9.

²²¹ *Id.* at 9, 13.

²²² See, e.g., Jaffe & de Rassenfosse, *supra* note 15, at 1363.

²²³ See Christopher A. Cotropia & David L. Schwartz, Patents Used in Patent Office Rejections as Indicators of Value 1 (Nov. 8, 2018) (unpublished manuscript), <https://ssrn.com/abstract=3274995> [<https://perma.cc/898Y-L9NY>].

²²⁴ 35 U.S.C. §§ 119, 120 (2018) (defining the familial relationships between patents in the same family). Familial relationships permit an applicant to obtain multiple patents based upon the same disclosure in some circumstances.

²²⁵ See, e.g., Jeffrey Kuhn & Kenneth Younge, Corrected Measures for Patent Citation Analysis: Accounting for Published Patent Applications 7 (July 28, 2019) (unpublished manuscript), <http://dx.doi.org/10.2139/ssrn.3428375> [<https://perma.cc/ZWQ8-XD9G>].

tent applications during prosecution.²²⁶ But, for the purposes of this study and ensuring our results are comparable to the majority of the current research, we stay with the conventional approach of comparing abandoned published patent applications to issued patents.

Starting with this dataset, we obtained citation information on all patents that issued, and applications that published, from January 1, 2000, to July 1, 2017. We chose the start date to narrow the universe of patents to coincide with the beginning of application publication in the United States. Further, we chose the end date to coincide with the last office action in the dataset. We then added to this dataset both patents and published applications that were not cited at all in this dataset and excluded design and plant patents from the dataset, which meant that our data included 3,525,385 utility patents and 4,285,400 published utility patent applications.

Once we defined the universe of patents and published applications, we sought to determine which published applications were “truly” abandoned. We sought to exclude those applications that were not truly abandoned. For example, a particular application that is published may become abandoned, but an application related (claims priority) to that abandoned application may eventually issue. The published application may have a parent or child application that includes a similar disclosure issue as a patent or is still pending at the time of this study, and consequently not be truly abandoned.²²⁷ Thus, to define “truly” abandoned applications, the status of both the published application and its parents and children were determined using the Patent Examination Research Dataset²²⁸ and the USPTO PatentsView data.²²⁹ Accordingly, a published application was identified as “truly abandoned” if that application, and its parents and children, were

²²⁶ For example, we performed the analysis below but combined the citation to an issued patent with citations to that issued patent’s published application. Once patent and published application citations are combined, abandoned patent applications, while still used by examiners, are not used as much as this combined metric. Abandoned applications are still heavily used. This heavy use of published applications is the focus of a current project we are working on.

²²⁷ A continuation is proper as long as it is filed during the pendency of the prior application, even if the prior application is later abandoned. See 35 U.S.C. § 120 (requiring that a continuation be “filed before the patenting or abandonment of or termination of proceedings on the first application”).

²²⁸ Stuart J.H. Graham et al., *The USPTO Patent Examination Research Dataset: A Window on Patent Processing*, 27 J. ECON. & MGMT. STRATEGY 554, 555, 574 (2018) (describing data issues including selection issues and the representativeness of the nearly 9.2 million U.S. patent application records contained in the USPTO Patent Examination Research Dataset). For a free download of the USPTO dataset, visit *Patent Examination Research Dataset (Public PAIR)*, U.S. PAT. & TRADEMARK OFF., <https://www.uspto.gov/learning-and-resources/electronic-data-products/patent-examination-research-dataset-public-pair> [<https://perma.cc/Y924-JYWE>].

²²⁹ Data Download, USPTO PATENTSVIEW, <http://www.patentsview.org/download/> [<https://perma.cc/UWM9-M3G3>].

abandoned as of December 1, 2018. Of the 4,285,400 published applications, 863,194 were identified as “truly” abandoned. From here forward, this Article will refer to these “truly” abandoned applications as simply “abandoned.”

We collected additional information about the patents and published abandoned applications in our data from the Patent Examination Research Dataset, USPTO PatentsView, and patents and published abandoned applications themselves.²³⁰ This additional information included:

- the number of words in the description;
- the number of figures;
- the U.S. Patent Classification;
- the small entity status of the patent or application;
- the title;
- whether the patent or application claimed priority to a foreign patent application.²³¹

We also relied on the Patent Examination Research Dataset to collect information about the patent prosecution and published abandoned applications in our data. The number of office actions, including non-final and final, was identified as well as the number of times the applicant appealed to the Board or filed an RCE when prosecuting the patent. We also determined whether the USPTO entered a notice of allowance for the published abandoned applications. The total number of transactions with the USPTO was identified. The number of parents and child non-provisional applications was also determined.²³²

B. Results

Now we present our empirical findings. We first report summary statistics on abandoned published applications, including a comparison to issued patents during the same time period. We have isolated the published patent applications that were abandoned without any patent rights provided to the applicant. That means that there were no parents, continuations, continua-

²³⁰ The number of words in the description and number of figures for patents and published abandoned applications was collected by obtaining published applications from patents.google.com and running a script to determine these various patent characteristics because the USPTO’s research datasets did not provide such information. The authors plan on publicly providing this information in the near future. In the meantime, feel free to contact the authors for the data.

²³¹ There were no publicly available databases with information on the number of claims, figures, or words in the specification for published patent applications.

²³² If an application claimed priority to a provisional application, we did not count it as a child. We only included priority claims to non-provisional applications.

tions-in-part, or divisional applications granted or pending as of December 1, 2018. To reiterate, we found 863,194 truly abandoned published applications out of the 4,285,400 applications that were published after 2000.²³³ Thus, just above twenty percent (20.14%) of published applications have gone abandoned during the time period of our study.²³⁴

1. Characteristics of Patents and Abandoned Published Applications

In Table I below, we report the summary statistics on family characteristics and small entity status.²³⁵ We report the means for abandoned applications compared with issued patents, for which the differences are all statistically significant to $p < 0.001$.²³⁶ A more detailed reporting of these descriptives, and others set forth below, can be found in the Appendix, Tables IV through VII.

Table I: Summary Statistics on Patent Families

	Abandoned applications	Issued patents
# Observations	863,194	3,525,385
# Parents	0.388	0.844
# Children	0.049	0.547
Small entity	0.295	0.192
Foreign priority	0.593	0.397
# Office actions	2.07	1.69
# RCEs	0.301	0.344
# Prosecution transactions	37.02	49.95
# Board appeals	0.072	0.070

²³³ We truncated our analysis of abandoned and non-abandoned applications as of June 2017, when the USPTO dataset ends.

²³⁴ If a published application and its child both went abandoned, then each would be in our list of published abandoned applications. Similarly, if a published application and its child both issued as patents, then both would be in our list of issued patents.

²³⁵ A small entity is: (i) a nonprofit organization; or (ii) a company that does not, together with all affiliates, have five hundred or more employees, and that has not assigned, licensed, or otherwise conveyed an interest in the invention to a non-small entity. *See* 37 C.F.R. § 1.27 (2019) (defining small entity status and noting that small entities are permitted to pay reduced fees to the USPTO).

²³⁶ The result is from a t-test. A t-test evaluates the differences between the means of two groups. Here, the two groups are abandoned applications and issued patents. A one-tail and two-tail p-value of less than 0.001 denotes that there is less than a 0.1% likelihood that the differences between the two groups were by chance.

Not surprisingly, issued patents have significantly more parent applications and child applications. In fact, there are roughly ten times more parents and children.²³⁷ Applicants may be more willing to invest in continuations when the USPTO has granted some patent rights. In contrast, more abandoned applications claim priority to foreign patent applications (59.3% versus 39.7%). The existence of potential foreign patent rights, and the fact that a foreign application was filed first, may account for the increased willingness to abandon a U.S. application in addition to the lower value of U.S. protection compared to protection in the foreign jurisdiction.²³⁸ For small entity status, abandoned published applications were more likely to be held by small entities (29.5% versus 19.2%). This is consistent with smaller companies having fewer resources to devote to patent prosecution. Fewer resources result in more applications going abandoned.²³⁹

Table I further reports on summary statistics on various attributes of patent prosecution. Specifically, we tabulate the number of office actions, the number of appeals to the Board, the number of RCEs, and the number of prosecution transactions. This last metric provides the number of documents in the file wrapper of the application.

Abandoned applications had, on average, more office actions than issued patents. In contrast, there are fewer RCEs and prosecution transactions for abandoned applications than for issued patents. Abandoned applications had about thirty percent fewer prosecution transactions than issued patents. The increased number of prosecution transactions for issued patents can be partially explained by additional papers reflecting payment of the issue fee and issuance of the patent. These issuance-related documents, however, do not explain the full difference in prosecution transactions between abandoned applications and issued patents.

²³⁷ We wonder why abandoned applications have any children applications. Perhaps they are divisionals. Otherwise, a rational applicant should file an RCE instead of a continuation. Scott D. Barnett, Note, *The Controversy Surrounding Continuing Applications and Requests for Continued Examination*, 7 J. MARSHALL REV. INTELL. PROP. L. 545, 548–50 (2008). Continuations move the applications back to the beginning of the queue for examination. *See id.* at 550 (“Consequently, a RCE enters the examination queue in the place where the parent application sat prior to the final Office action, but a continuing application, having a new file date, goes to the back of the examination queue.”).

²³⁸ This also presents the question as to whether those U.S. abandoned published applications are truly abandoned if a foreign patent was obtained.

²³⁹ The average cost of patent prosecution varies by technology and complexity. On average, the fees are between \$7500 and \$30,000, including USPTO filing fees and attorney time for drafting and prosecution. *See Masur, supra* note 184, at 699–700 (providing estimates of attorney fees for patent prosecution); Gene Quinn, *The Cost of Obtaining a Patent in the US*, IPWATCHDOG (Apr. 4, 2015), <https://www.ipwatchdog.com/2015/04/04/the-cost-of-obtaining-a-patent-in-the-us/id=56485> [<https://perma.cc/693A-EK4V>].

2. Citation and Rejection Uses of Patents and Abandoned Published Applications

Below in Table II, we report basic information about citations and uses in rejections. We report how often each patent and abandoned published application in our data was cited during the prosecution of another application.²⁴⁰ As previously noted, citations can arise from the applicant (typically via a Form 1449), citing the patent or published application, or the patent examiner. We report both separately and then provide a measure of all citations.²⁴¹ The means are reported below, and all are statistically significant to $p < 0.001$. Additional descriptive statistics on citations are reported in Appendix B.

Table II: Summary Statistics on Basic Citation Characteristics

	Abandoned applications	Issued patents
Applicant citations	2.357	3.445
Examiner citations	1.384	1.140
102 uses	0.142	0.102
103 uses	0.612	0.332

The citation data provides some interesting information. Issued patents are cited more by applicants (3.445) than abandoned applications (2.357), overall. The trend switches for examiner citations. Examiners cite to abandoned applications (1.384) more than issued patents (1.140). This is surprising given the conventional wisdom that abandoned applications are not valuable,²⁴² and thereby raises the question of why examiners are citing to them during the prosecution of other patent applications.

Table II also shows that abandoned applications are used more than issued patents in both anticipation (0.141 to 0.102) and obviousness (0.612 to 0.332) rejections by the USPTO. The numbers for obviousness rejections are especially interesting: the USPTO cites to an abandoned application at over twice the rate, on average, that it cites to an issued patent.

To analyze citations in more detail, we performed a series of ordinary least-square (OLS) regressions. Table III, reproduced in the Appendix, pro-

²⁴⁰ We recently studied the usage of patents in anticipation and obviousness rejections. See Cotropia & Schwartz, *supra* note 223, at 1–9.

²⁴¹ Some patents and published applications are cited by both the applicant and the examiner. Consequently, one cannot merely add the applicant and examiner citation numbers to reach the All Citation numbers.

²⁴² See *supra* Part I.C.

vides the results of our most detailed model for four citation/use metrics: (1) applicant citations, (2) examiner citations, (3) § 102 rejection uses, and (4) § 103 rejection uses.

Our regression results are consistent with the summary statistics. After controlling for the year of the availability of the patent or abandoned published applications,²⁴³ RCEs, small entity status, related applications, and other variables, including technology class, abandoned applications are negatively correlated with application citations, while positively correlated with examiner citations, as well as § 102 and § 103 rejection uses. This result is puzzling if abandoned applications were worthless. Why are examiners citing to them frequently, and why are examiners using them in § 102 and § 103 rejections more than examiners use issued patents?

To be sure, examiners use published applications as prior art differently from how they examine the application itself. When examining the application, the USPTO focuses on the claims, determining whether they meet all of the requirements for patentability. In contrast, when a patent examiner is searching for prior art, she focuses on the disclosure in the specification. The figures and detailed description are important there, not the claims.

3. Reasons for Examiners to Cite and Use Abandoned Applications

The question then becomes why are abandoned applications cited at such a high rate, particularly by examiners, and used in § 102 or § 103 rejections. In order to explore this further, we look to see if this citation and use is associated with either (a) the allowance of the abandoned application, meaning the applied-for invention was patentable but abandoned for some reason, or (b) the abandoned application was finally rejected as not novel under § 102—meaning that earlier prior art already disclosed the invention²⁴⁴—or obvious under § 103—meaning that the abandoned application is the first to disclose all elements of the invention in one place, yet their combination is obvious.²⁴⁵

One theory is that these abandoned applications receiving such high usage are applications that the patent office allowed, but abandoned prior to issuance. Perhaps these are patentable inventions that went abandoned due to individual shortcomings in funding or vision of their inventors. But their usage of the USPTO is driven because no other prior art provides the new and nonobvious insights in the abandoned application.

²⁴³ We also ran the regression with the filing date of the patent or abandoned published applications, and the results did not substantially change.

²⁴⁴ 35 U.S.C. § 102.

²⁴⁵ *Id.* § 103.

To explore this, we looked at the citation rate of abandoned applications divided between those that were given a notice of allowance and those that were not. By definition, the abandoned applications with a notice of allowance were deemed novel and nonobvious by the USPTO. We included in this group abandoned applications where at least some claims were allowed after the final office action, meaning there was at least one patentable invention in the application.²⁴⁶ It turns out the citation rates for these “allowed” abandoned applications were not statistically different in any of the citations categories compared to the abandoned applications where the USPTO found nothing allowable (or were abandoned before the USPTO was even allowed to evaluate the application).²⁴⁷

This finding dismisses the explanation that abandoned applications are cited at a higher rate because of the patentable inventions found therein. The USPTO is not significantly citing and using abandoned applications because they provide information not found in other prior art.

Another theory is that abandoned applications, while disclosing unpatentable subject matter, provide a contribution by combining information found in the prior art in a single place. More specifically, this theory posits that the abandoned applications are compilations of multiple pieces of prior art, and the compilation has some special value to the USPTO. We can test this by exploring the unallowed abandoned applications to see if the reason for their final rejection was lack of novelty or obviousness. A final obviousness rejection indicates that the abandoned application was the first to disclose the novel combination, but the combination was obvious.²⁴⁸

Although there are a variety of rejection types, the two we focused on were whether the abandoned application was abandoned after a § 102 rejection, meaning that the claimed invention in the abandoned application was not novel.²⁴⁹ The examiner was able to find the abandoned application’s invention in a single piece of prior art. A second category were applications abandoned after a § 103 rejection. This meant that the abandoned application’s invention had not been done before, but was an obvious combination of the prior art.²⁵⁰ This second category could be broken down even further into those final rejections that involved more than three pieces of prior art

²⁴⁶ We only have such allowed claim data for a limited set of U.S. patent applications from 2007 through 2017.

²⁴⁷ The results of a chi-squared test for all four citation metrics—applicant, examiner, § 102, and § 103 use—were not statistically significant when comparing allowed and not allowed abandoned applications.

²⁴⁸ 35 U.S.C. § 103.

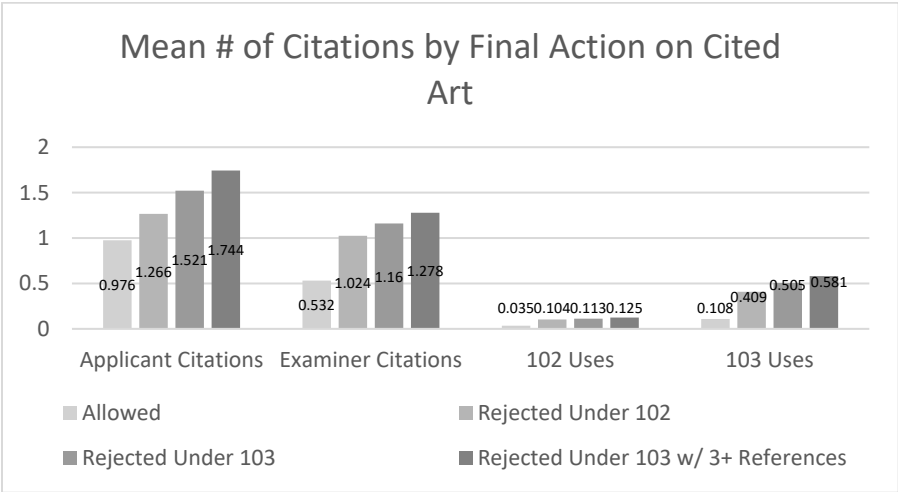
²⁴⁹ *Id.* § 102.

²⁵⁰ *Id.* § 103.

that needed to be combined to render the abandoned application’s invention obvious. This meant that the abandoned application brought together teachings from many prior disclosures, yet still in an obvious way.

The findings based on these final rejection types (and the allowed patents and abandoned applications) are shown below in Figure 2. Notably, the abandoned applications rejected under § 103, particularly those that needed more than three pieces of prior art, are cited more on average by applicants and examiners and used more in future § 102 and § 103 rejections.

Figure 2



This provides insight into what examiners are finding in abandoned applications—a single piece of art (the abandoned application) that combines the teachings from multiple other pieces of prior art in one place. That is, abandoned applications are valuable compendiums of sorts. The examiner does not need to rely on multiple pieces of prior art but, instead, can simply rely on the single abandoned application as a prior disclosure of the invention.²⁵¹

4. Impact of the USPTO Using Abandoned Applications in Rejections

We can also observe how the usage of abandoned applications impacts future patent applications. In particular, we examined if the USPTO allowed any claims of the patent application against which the abandoned applica-

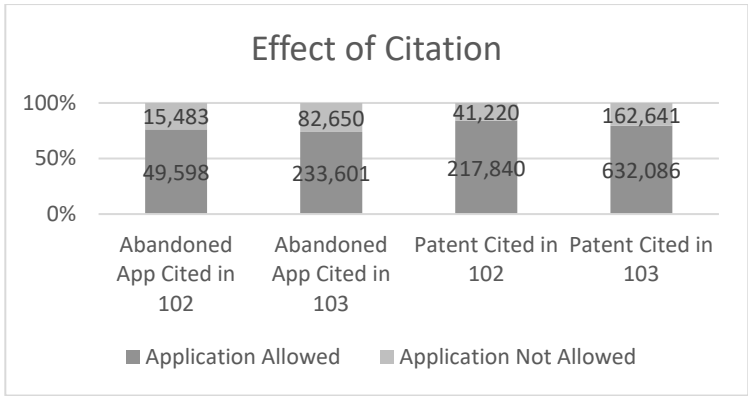
²⁵¹ This is very important in that the typical challenge to an obviousness rejection is that there is no reason to combine the prior art references. No such argument can be made if the information is found within the four corners of a single piece of art.

tion was cited. Put another way, did the citation of the abandoned application in a § 102 or § 103 rejection result in that patent application not being allowed?²⁵² If so, then the abandoned applications likely resulted in more space being left in the public domain.

For 1,087,777 patent applications,²⁵³ we had data on whether the USPTO allowed any claims for that patent application and whether, in the last rejection, the prior art used to reject the patent application was abandoned application art or not. For patent applications where an abandoned application was used in the last office action, 255,993 (74.24%) were allowed and 88,816 (25.76%) were not. In comparison, the usage of an issued patent in the final office action resulted in 607,055 (81.71%) patent applications being allowed versus 135,913 (18.29%) not being allowed. Interestingly, the usage of abandoned applications in final rejections correlated with a lower allowance rate compared to the usage of patents.

This information can be further broken down by the specific use of the abandoned application or patent in the final office action—whether they were used in a § 102 or § 103 rejection. Below, in Figure 3, the effect of an abandoned application’s (and issued patent’s) use in a § 102 or § 103 rejection is reported.

Figure 3



For both § 102 and § 103 rejections in the last office action, a lower percentage of patent applications were allowed over abandoned applications compared to patents. The raw numbers of denied patent applications were, however, higher for patent usage in § 102 and § 103 rejections. For both

²⁵² We did not have readily available data on claim narrowing caused by the usage of abandoned applications in final office actions. This would provide another indicator of the effect of usage of abandoned applications in future patent applications.

²⁵³ Again, we limited our study to those for which we have allowed claims data.

categories of prior art, less patent applications were allowed over § 103 rejections compared to § 102 rejections. These numbers show a quantifiable impact of the usage of abandoned applications. The public domain is maintained by roughly twenty-five percent of patent applications with attempts to gain exclusivity being denied based on an abandoned application. This suggests a meaningful benefit to the public from the administrative disclosure provided by abandoned applications.

To provide a specific example of an abandoned application clearing space in the public domain, consider U.S. Patent Application Publication No. 2004-0112426, entitled “Solar cell and method of manufacturing the same” (Abandoned Solar Cell Patent Application).²⁵⁴ The Abandoned Solar Cell Patent Application was filed in the United States on December 10, 2003, by Masato Hagino of Japan.²⁵⁵ It is one of most used abandoned patent applications by the USPTO. The Abandoned Solar Cell Patent Application was assigned to the Sharp Corporation (Sharp) in Japan and claimed priority to a Japanese patent application filed on December 11, 2002. In the application, Sharp attempted to claim a solar cell with particular characteristics.²⁵⁶ Despite publication of the application in 2004, the USPTO had not acted on the application by mid-2005. The applicant made a status request on June 10, 2005, seeking information on when they could expect a response.²⁵⁷ The USPTO never responded to the status request. Nothing occurred until August 21, 2007, when the USPTO told the applicant that the application covered two separate inventions. The USPTO asked the applicant to select one invention, either solar cells or methods of making solar cells.²⁵⁸ Instead of responding to the examiner’s restriction requirement, Sharp let the Abandoned Solar Cell Patent Application go abandoned on

²⁵⁴ Notice of Abandonment, U.S. Patent Application No. 10/731,009 (Apr. 11, 2008).

²⁵⁵ U.S. Patent Application No. 10/731,009 (filed Dec. 10, 2003), U.S. Patent Publication No. 2004-0112426 (June 17, 2004).

²⁵⁶ Claim 1 of the Abandoned Solar Cell Patent Application recited:

A solar cell comprising: a dopant diffusion layer formed on a side of a light-receiving surface of a silicon wafer; a light-receiving surface passivation film formed on said dopant diffusion layer, said light-receiving surface passivation film having an opening portion; and a light-receiving surface electrode formed on the opening portion of said light-receiving surface passivation film, wherein said dopant diffusion layer has a first region covered with said light-receiving surface passivation film and a second region under the opening portion of said light-receiving surface passivation film, and there is a difference between a dopant concentration in said first region and a dopant concentration in said second region.

Id. at 6–7.

²⁵⁷ Status Inquiry, U.S. Patent Application No. 10/731,009 (June 10, 2005).

²⁵⁸ Requirement for Restriction/Election, U.S. Patent Application No. 10/731,009 (Aug. 21, 2007).

April 11, 2008.²⁵⁹ Thus, Sharp obtained no rights to exclude others from the invention disclosed in the application. Shortly after Sharp's application went abandoned, on May 13, 2008, three other inventors filed a U.S. patent application entitled "Solar cell having a high quality rear surface spin-on dielectric layer" (2008 Solar Cell Application).

The 2008 Solar Cell Application was assigned to Georgia Tech Research Corporation (Georgia Tech), and published approximately eighteen months from filing, on December 10, 2009. The 2008 Solar Cell Application attempted to claim a solar cell.²⁶⁰ On July 16, 2010, the USPTO rejected all of the pending claims in the 2008 Solar Cell Application as being obvious.²⁶¹ The USPTO based its obviousness rejection primarily upon the earlier Abandoned Solar Cell Patent Application. The patent examiner contended that the Abandoned Solar Cell Patent Application contained every element of the broadest Sharp claim except for the precise thickness of the silicon wafer.²⁶² The patent examiner asserted that a second reference provided the thickness. The patent examiner asserted that a person of skill in the art would have combined the disclosure of the Abandoned Solar Cell Patent Application with another reference to arrive at the Georgia Tech invention.²⁶³ Instead of responding to the examiner's rejection, Georgia Tech let the 2008 Solar Cell Application go abandoned on March 1, 2011.²⁶⁴ Thus, Georgia Tech received no patent rights whatsoever.

In this instance, the 2008 Solar Cell Application, via its disclosure, prevented Georgia Tech from obtaining rights. If the USPTO had granted the Georgia Tech application, then Georgia Tech would have had the right to exclude others from its claimed solar cell until May 2028. In this manner,

²⁵⁹ Notice of Abandonment, U.S. Patent Application No. 10/731,009 (Apr. 11, 2008).

²⁶⁰ Claim 1 of the filed application recited:

A solar cell, comprising: a thin crystalline silicon wafer having a thickness less than 300 micrometers comprising a p-region coupled to an n-region; a spin-on dielectric layer coupled to the rear surface of the silicon wafer to protect the silicon wafer from contaminants during a diffusion process and to provide rear surface passivation, wherein the spin-on dielectric layer has a thickness from 1500 to 2500 angstroms, wherein the spin-on dielectric layer has strengthened bonds through a curing process performed during the diffusion process; a thermally grown dielectric layer coupled to the front surface of the silicon wafer to provide front surface passivation, wherein the thermally grown dielectric layer has a thickness from 100 to 200 angstroms.

U.S. Patent Application No. 12/120,057, at 4 (filed May 13, 2008), U.S. Patent Publication No. 2009/0301559 (Dec. 10, 2009).

²⁶¹ Non-Final Rejection, U.S. Patent Application No. 12/120,057 (July 16, 2010).

²⁶² *See id.* at 3.

²⁶³ *See id.*

²⁶⁴ Abandonment, U.S. Patent Application No. 12/120,057 (Mar. 1, 2011).

the abandoned patent application cleared potential private property rights, leaving that space open in the public domain. Although the 2008 Solar Cell Application has no value to Sharp after abandonment, it is not worthless to the public. It prevented Georgia Tech from obtaining patent rights.

In addition, the use of the Abandoned Solar Cell Patent Application in the prosecution of the later Georgia Tech application suggests that the technology described in both applications is at least of some value. The fact that the USPTO used the Abandoned Solar Cell Patent Application to reject the Georgia Tech application means that at least two entities performed some research in this technological area and devoted the resources to draft and file a patent application describing this technology. Although both abandoned patent applications have no private value, due to their abandoned statuses, their existence—particularly the existence of two applications in the same technological space—indicates there is some consensus that such a technology has some value. This value was significant enough that two independent firms both researched and filed for patent protection. The abandoned patent application may be worthless as a patent, but its existence and use suggest that the technology has some worth, at least initially, to both applicants.

III. IMPLICATIONS OF FINDING THE “HIDDEN” VALUE OF ABANDONED APPLICATIONS

Our findings raise significant questions about the conventional wisdom surrounding abandoned applications and patent disclosure in general. If abandoned applications are worthless, then why are they relied upon so heavily by the USPTO in examining other applications?²⁶⁵ The empirical data indicates that, although the abandoned application may be worthless to its applicant, the disclosure itself and the technology described therein have value.²⁶⁶

Below we discuss the implications of our findings about abandoned patent applications for patent law theory. Section A of this Part highlights a theory of patent disclosure not discussed or appreciated: administrative disclosure.²⁶⁷ The public nature of these abandoned applications, allowing them to be used when examining the patentability of future patent applications, is valuable to the patent system as a whole. Section B explains how the fact that others are inventing and filing applications on the same technology disclosed in abandoned applications emphasizes the value of this technolo-

²⁶⁵ See *supra* Part II.B.

²⁶⁶ See *supra* Part II.B.

²⁶⁷ See *infra* Part III.A.

gy.²⁶⁸ The information from these forward citations exposes the value of the disclosed technology, even if it is contained in an abandoned application.

A. Recognizing the Administrative Disclosure of Patents

We first turn to policy debates about patent disclosure more broadly. As noted in Part I.B, legal scholars have questioned the value of the disclosure provided by issued patents.²⁶⁹ Scholars have claimed that scientific researchers ignore patents.²⁷⁰ Others have questioned the overall value of the information contained in a patent's specification.²⁷¹

Our findings indicate that there is an audience that reads these patent disclosures carefully—patent examiners.²⁷² The level of use of the disclosures by this audience is so high that the USPTO reads and often uses even abandoned patent applications.²⁷³ We find that patent examiners cite to abandoned applications as a significant source of prior art.²⁷⁴ Not only do they read the disclosures, but patent examiners use them for rejections on the basis of anticipation and obviousness. In fact, we find that examiners are more likely to use these abandoned patent applications than issued patents.²⁷⁵

In particular, abandoned applications are extremely useful in documenting the teachings of multiple pieces of prior art in one piece of art. This allows the USPTO to cite one reference, the abandoned application, instead of many to establish that a future patent application is not patentable. The compendium nature of an abandoned application also helps the USPTO avoid needing to prove a reason to combine multiple prior art teachings to reject an application, because the abandoned application has already done this for them. This means that abandoned applications provide valuable disclosure of information to the USPTO.

This utilization of abandoned patent applications by the USPTO highlights a disclosure function we call the administrative disclosure. The patent application's disclosure has value to the administration of patent law; more specifically, the examination of patent applications. As discussed in detail above, patent examiners are tasked with determining whether a patent ap-

²⁶⁸ See *infra* Part III.B.

²⁶⁹ See *supra* Part I.C.1.

²⁷⁰ See, e.g., Lemley, *supra* note 9, at 21 (asserting that third parties are deliberately ignorant of prior art).

²⁷¹ Seymore, *supra* note 198, at 398–99; *Disclosure Function*, *supra* note 199, at 2007.

²⁷² See PURVIS, *supra* note 35, at 8–9 (explaining that examiners play a crucial role in examining patents and facilitating the patenting process); *supra* Part I.A.

²⁷³ See *supra* Part II.B (finding examiners cite and use abandoned published applications when examining other patents).

²⁷⁴ See *supra* Part II.B.

²⁷⁵ See *supra* Part II.B.

plication meets the patentability requirements.²⁷⁶ A major part of this administrative function is searching for and applying prior art.²⁷⁷ The availability of abandoned patent application disclosures assists heavily in this administrative activity. The data shows that even an abandoned patent application's disclosure is of value to patent examiners, who significantly rely upon them to police the patentability of future patent applications.²⁷⁸

The administrative disclosure function of patents is particularly important when considering the accessible and evidentiary nature of such disclosures. By definition, patents and patent applications are publicly available and easily searchable.²⁷⁹ Patent examiners, or other patent players evaluating the patentability of a patent claim, can easily find such disclosures that may challenge the novelty or nonobviousness of an invention. These disclosures are stored in searchable formats and systems, making the discovery of relevant disclosures more likely.²⁸⁰

Furthermore, the official, administrative nature of these patents and patent applications avoids possible evidentiary problems experienced by some prior art. These documents are self-authenticating, removing questions of whether that particular disclosure is the actual disclosure available on the publication date.²⁸¹ Typically, when presenting a document or device, the "proponent must produce evidence sufficient to support a finding that the item is what the proponent claims it is."²⁸² But certified copies of patents or published patent applications, available from the USPTO,²⁸³ are by their

²⁷⁶ See Lemley & Sampat, *supra* note 40, at 6–7, 12; *supra* Part I.A.

²⁷⁷ Lemley & Sampat, *supra* note 40, at 11–12.

²⁷⁸ Some have argued that changing the time allotted to patent examiners would materially improve the patent system. See Michael D. Frakes & Melissa F. Wasserman, *Irrational Ignorance at the Patent Office*, 72 VAND. L. REV. 975, 1030 (2019) (arguing that giving patent examiners more time for examination would improve the quality of examination and be cost-beneficial overall).

²⁷⁹ For example, patents and published applications are readily viewable at patents.google.com and the USPTO's own website.

²⁸⁰ Examiners can easily find and search these patents and published applications in USPTO databases called the Examiner Automated Search Tool (East) and Web Examiner Search Tool (West). See PRIOR ART: FREQUENTLY ASKED QUESTIONS, *supra* note 42, at 3.

²⁸¹ See, e.g., *Lighting Ballast Control, LLC v. Philips Elecs. N. Am. Corp.*, No. 7:09-CV-29-O, 2011 WL 13128125, at *10 n.5 (N.D. Tex. May 4, 2011) (finding patents self-authenticating under FED. R. EVID. 902).

²⁸² FED. R. EVID. 901(a) ("To satisfy the requirement of authenticating or identifying an item of evidence, the proponent must produce evidence sufficient to support a finding that the item is what the proponent claims it is.").

²⁸³ See, e.g., *CA, Inc. v. Simple.com, Inc.*, 780 F. Supp. 2d 196, 305–06 (E.D.N.Y. 2009) (holding that a "JavaScript Bible" publication was self-authenticating because it bore "the seal of the Copyright office" and "the signature of the Register of Copyrights").

very nature considered self-authenticating.²⁸⁴ There are no authentication problems when dealing with patents and published patent applications.²⁸⁵

Patents and published patent applications also avoid hearsay problems regarding the date listed on the document.²⁸⁶ As detailed in Part I.A above, the date of publication is incredibly important when evaluating whether a published application, or patent, is prior art. Thus, a patent examiner, or other challenger of a patent's validity, wants to establish the date such a prior art was publicly available.²⁸⁷ A listed date on the face of the prior art, without more, is hearsay to establish the truth that the prior art was publicly available on that listed date.²⁸⁸ Patents and published patent applications avoid this hearsay problem, falling under the public records exception to hearsay.²⁸⁹ These disclosures can speak to the truth of the information contained therein, including the listed publication and issuance date.

The administrative disclosure value of these published abandoned applications goes beyond the simple use of the disclosure in examination. The USPTO patrols the boundary between private patent rights and the public

²⁸⁴ Federal Rule of Evidence 902 states:

The following items of evidence are self-authenticating; they require no extrinsic evidence of authenticity in order to be admitted: (1) *Domestic Public Documents That Are Sealed and Signed*. A document that bears: (A) a seal purporting to be that of the United States; any state, district, commonwealth, territory, or insular possession of the United States; the former Panama Canal Zone; the Trust Territory of the Pacific Islands; a political subdivision of any of these entities; or a department, agency, or officer of any entity named above; and (B) a signature purporting to be an execution or attestation.

FED. R. EVID. 902 (emphasis added).

²⁸⁵ Other types of prior art, such as public uses and sales, have greater evidentiary hurdles for patent challenges and require additional corroboration. Mike R. Turner, Note, *The Future of the Corroboration Requirement in Patent Law: Why a Clear, Strict Standard Benefits All*, 2008 U. ILL. L. REV. 1319, 1322–23 (noting that public uses and sales require documentary corroboration of witness testimony). One study has found significant uses of these types of prior art in district court rulings. See Stephen Yelderman, *Prior Art in the District Court*, 95 NOTRE DAME L. REV. 837, 860 (2019) (finding that a majority of anticipation decisions in the district court relied upon public uses, sales, and inventive activity).

²⁸⁶ See, e.g., *Apple Inc. v. DSS Tech. Mgmt., Inc.*, No. IPR2015-00373, at 10–11 (P.T.A.B. June 25, 2015) (finding that the date stamped by a library on the cover page of alleged prior art is hearsay when offered to prove the date of public accessibility); Anthony C. Tridico et al., *Proving “Prior Art” at the PTAB*, FINNEGAN (Jan. 2016), <https://www.finnegan.com/en/insights/articles/proving-prior-art-at-the-ptab.html> [<https://perma.cc/7ZCJ-S4EH>].

²⁸⁷ See 35 U.S.C. § 102 (2018).

²⁸⁸ FED. R. EVID. 801; *QSC Audio Prods., LLC v. Crest Audio, Inc.*, No. IPR2014-00129, at 10–11 (P.T.A.B. Apr. 29, 2015) (noting that a copyright notice with a date, by itself, is hearsay).

²⁸⁹ See FED. R. EVID. 803; *Fresenius Med. Care Holdings, Inc. v. Baxter Int’l, Inc.*, No. C 03-1431 SBA, 2006 WL 1330003, at *3 (N.D. Cal. May 15, 2006) (“The United States Patent and Trademark Office (“PTO”) is an agency of the United States, within the Department of Commerce, and thus falls squarely within the ‘public offices or agencies’ requirement of Rule 803(8).”).

domain.²⁹⁰ When the USPTO grants an applicant broad claims to an invention, others without permission cannot practice the claimed invention.²⁹¹ Rejections on the basis of anticipation and obviousness often require narrowing amendments by applicants in order to place the claims in condition for allowance by the USPTO. By requiring that the applicant narrow the claims, the exclusive rights provided are narrower. The administrative disclosure, therefore, not only assists in the examination of a specific patent application; it also opens inventive space to the public by forcing future applicants to either narrow their claims or abandon their applications altogether.²⁹²

This aspect of patent examination, requiring narrowing amendments or abandonment due to prior art, is important to the system in which abandoned applications play a substantial role. Take the solar cell technology example from Part II.B, above. There, the Abandoned Solar Cell Patent Application, via its disclosure, prevented Georgia Tech from obtaining rights on this technology.²⁹³ This means that the technology disclosed in the abandoned patent application is open to public use.²⁹⁴ Opening up the public domain for others is another value of the disclosure to the patent system as a whole.

Accordingly, the administrative disclosure—the disclosure in abandoned applications—provides value to the system. And this value goes beyond abandoned patent applications. The administrative disclosure theory applies to all patents and published patent applications. In the same way abandoned published patent applications are used in examination to both administer the patent laws and open up the public domain, so are patents and published applications of issued patents, particularly once they expire. Our findings highlight the administrative disclosure benefits of the patent document, particularly after the AIPA provided for the publication of applications.²⁹⁵

²⁹⁰ See *supra* Part I.A.

²⁹¹ 35 U.S.C. § 271(a) (“Except as otherwise provided in this title, whoever without authority makes, uses, offers to sell, or sells any patented invention, within the United States, or imports into the United States any patented invention during the term of the patent therefor, infringes the patent.”).

²⁹² See *supra* note 14 and accompanying text.

²⁹³ See *supra* Part II.B.2.

²⁹⁴ There could, however, be earlier patents that are enforced and blocking the technology. See, e.g., Mark A. Lemley, *The Economics of Improvement in Intellectual Property Law*, 75 TEX. L. REV. 989, 991, 1011, 1067 (1997); Robert P. Merges & Richard R. Nelson, *On the Complex Economics of Patent Scope*, 90 COLUM. L. REV. 839, 866 (1990).

²⁹⁵ 35 U.S.C. § 122(b)(1)(A) (allowing for publication of applications).

*B. Highlighting the Value of Technology Described
in Abandoned Applications*

Another value is uncovered by looking at the citation and use of abandoned patent applications: the value of the disclosed technology. Although the private value of the abandoned application is likely zero to the initial inventor due to abandonment, the fact that others try to get patents for similar technologies speaks to the value of the underlying technology in general. This conclusion leverages the generally accepted theory that forward citations of a patent are an indicator of value of the described technology.

Previous research established that forward citation, the number of times a subsequent patent cites an earlier patent, is an indicator of that cited patent's value.²⁹⁶ The reasoning behind this finding is that "[t]he very existence of those later patents attests to the fact that the cited patents opened the way to a technologically successful line of innovation."²⁹⁷ Put another way, the number of times a patent is cited by other patents is "a measure of its technological significance"²⁹⁸—that the technology in the cited patent is important because others, in their patent applications, are continuing to employ the same technology.²⁹⁹ Another reason forward citations evidence value in the described technology is that they can measure "knowledge spillovers" under the assumption that "a citation of Patent X by Patent Y means that X represents a piece of previously existing knowledge upon which Y builds."³⁰⁰

Scholars, including ourselves, have built on and tested this theory. Deepak Hegde and Bhaven Sampat recognized that citations by patent examiners, as opposed to applicants, are more reliable indicators of value.³⁰¹ Hegde and Sampat found that "[e]xaminer citations to a patent are stronger predictors than applicant citations" as to whether a patent "has been (or will

²⁹⁶ See, e.g., Jaffe & de Rassenfosse, *supra* note 15, at 1361–62; Lanjouw, Pakes & Putnam, *supra* note 15, at 417–18; Trajtenberg, *supra* note 15, at 174. See generally, e.g., JAFFE & TRAJTENBERG, *supra* note 15.

²⁹⁷ See Trajtenberg, *supra* note 15, at 174.

²⁹⁸ See OFFICE OF TECHNOLOGY ASSESSMENT AND FORECAST, U.S. PATENT & TRADEMARK OFFICE, U.S. DEP'T OF COMMERCE, TECHNOLOGY ASSESSMENT AND FORECAST 167 (Sixth Report 1976).

²⁹⁹ See Peter Thompson, *Patent Citations and the Geography of Knowledge Spillovers: Evidence from Inventor- and Examiner-Added Citations*, 88 REV. ECON. & STAT. 383, 384–88 (2006).

³⁰⁰ See Adam B. Jaffe et al., *Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations*, 108 Q.J. ECON. 577, 589 (1993).

³⁰¹ See Deepak Hegde & Bhaven Sampat, *Examiner Citations, Applicant Citations, and the Private Value of Patents*, 105 ECON. LETTERS 287, 289 (2009) (finding that examiner patent citations predict patent value better than applicant patent citations).

be) renewed.”³⁰² And the assumption is that a patentee only renews valuable patents (to keep them in force).³⁰³ We recently extended this research, finding that use of a patent in a rejection is an even stronger predictor of renewal than an examiner or applicant citation.³⁰⁴ All of this is to say that forward citation, but particularly use of a patent in a rejection of a future patent application, indicates that the cited patent is technologically significant and, thus, is valuable.³⁰⁵

In this study we focus on abandoned patent applications and still find significant forward examiner citation and use in rejections of these abandoned patent applications.³⁰⁶ This finding indicates that these cited and used abandoned patent applications describe technology that has value—just as forward citations and use of issued patents have in previous studies. This is a value that cannot be in the abandoned application itself, which is abandoned and unenforceable. But this finding does suggest, like forward citation does in general, that the described technology is significant and valuable. Others are inventing and filing patent applications in the same technological space, as evidenced by the citation and use of the abandoned applications. The industry players attempting to patent this technology presumably see some value in it.

This is a value beyond the administrative disclosure value discussed above. Certainly, the value evidenced by forward citation is part of the administrative disclosure theory, which discusses using an earlier patent disclosure to assist in the administration of the patent system. But the relevance indicated by the forward citation also speaks to the convergence of multiple firms on a particular technological space. This convergence provides at least some evidence that this technology is valuable. Individuals are devoting resources to invest in the invention and file patent applications on similar technology where the abandoned patent application is cited and possibly used.

The 2008 Solar Cell Application example discussed above is informative.³⁰⁷ Not only did Sharp invest in the invention and filing of a patent application on a specific type of solar panel technology in 2004; Georgia Tech engaged in a similar investment and patent application filing in 2008.³⁰⁸ The

³⁰² *Id.*

³⁰³ See Lanjouw, Pakes & Putnam, *supra* note 15, at 407.

³⁰⁴ See Cotropia & Schwartz, *supra* note 223, at 8.

³⁰⁵ *Id.* We recognize that it is possible that forward citations are not good proxies for value, and that our study supports that view. We leave for another day further analysis and consideration of the merits of utilizing forward citations as a value metric.

³⁰⁶ See *supra* Part II.B.

³⁰⁷ See *supra* Part II.B.4.

³⁰⁸ See *supra* Part II.B.2.

use of the Abandoned Solar Cell Patent Application by the USPTO to reject Georgia Tech's 2008 patent application means that the two inventions were similar. Two independent entities engaging in the same inventive activity over a four-year period, speaks to the disclosed technology's worth. At least two firms believed the technology to be valuable enough to pursue inventing and filing patent applications in a similar technological area.

This information—which technologies firms find valuable enough to research and file patent applications on—is another hidden value in abandoned patent applications. The AIPA's publication of these abandoned patent applications exposes valuable information to the public. This finding does, however, raise two questions that relate to mechanism. One question pertains to why the original inventor abandoned a patent application on a technology that others find valuable.³⁰⁹ The other relates to why patent examiners use abandoned applications as prior art at such high rates, including whether such citation is easier and whether the practice is only performed by certain patent examiners. These questions, which are beyond the scope of this Article, are the subject of a current research project by the authors.³¹⁰

CONCLUSION

By leveraging both the AIPA's legislative change in 1999 to publish abandoned patent applications and the recent USPTO Patent Examination Database, we uncover the hidden value of abandoned patent applications. Specifically, we empirically establish that patent examiners often cite abandoned patent applications and use them in rejections in future patent applications. These findings are contrary to the conventional wisdom that abandoned patent applications are worthless.

These findings also expose two specific sources of a patent disclosure's "worth" with implications beyond abandoned patent applications. Their use in rejections by the USPTO that cause, in some cases, others to not get patent protection, highlights the administrative disclosure benefits of published applications and patents (abandoned or not). Patent examiners read and use these disclosures to facilitate the effective operation of the patent system. This usage in future applications also helps identify the value of the described technology in general, even though the cited patent applica-

³⁰⁹ This question includes whether the inventor ran out of funds necessary to continue patent prosecution, whether the USPTO made an error in denying patent protection to the abandoned application, whether the inventor made an intentional and strategic decision to abandon the invention while creating prior art for others, and whether the inventor was able to monetize her invention by means other than patent protection.

³¹⁰ This research, including data analysis, is on file with the authors.

tion was abandoned. This finding is important as the data suggests that the USPTO uses abandoned applications to maintain space in the public domain.

Appendix
Additional Descriptives

Table III: OLS Regression on Citations and Rejection Uses³¹¹

	(1)	(2)	(3)	(4)
	Applicant Citations	Examiner Citations	102 Rejection Uses	103 Rejection Uses
Abandoned	-0.377*** (0.0174)	0.202*** (0.00315)	0.0392*** (0.000632)	0.259*** (0.00151)
# Words in Description	0.0000605*** (0.000000776)	0.0000214*** (0.000000141)	0.00000178*** (2.82e-08)	0.00000611*** (6.75e-08)
# of Figures	0.0175*** (0.000454)	0.00517*** (0.0000823)	0.000542*** (0.0000165)	0.00132*** (0.0000394)
Small entity	-0.680*** (0.0157)	0.0265*** (0.00284)	-0.00428*** (0.000570)	-0.00436** (0.00136)
Parent applications	0.0788*** (0.00418)	-0.0461*** (0.000759)	-0.00727*** (0.000152)	-0.0234*** (0.000364)
Children applications	0.884*** (0.00354)	0.0880*** (0.000642)	0.00976*** (0.000129)	0.0249*** (0.000308)
Foreign priority	-1.523*** (0.0127)	-0.308*** (0.00231)	-0.0273*** (0.000463)	-0.122*** (0.00111)
# of Office Actions	-0.177*** (0.00561)	0.00240* (0.00102)	0.000162 (0.000204)	0.0102*** (0.000488)
# of Appeals	-0.477*** (0.0211)	-0.0940*** (0.00383)	-0.0103*** (0.000767)	-0.0209*** (0.00183)
# of RCEs	0.0307***	0.00591***	0.000509***	0.00176***

³¹¹ We use the following notation: * p<0.05, ** p<0.01, *** p<0.001.

	(0.000464)	(0.0000841)	(0.0000169)	(0.0000403)
# of Prosecution Transactions	-0.680***	0.0265***	-0.00428***	-0.00436**
	(0.0157)	(0.00284)	(0.000570)	(0.00136)
Year	χ***	χ***	χ***	χ***
USPC	χ***	χ***	χ***	χ***
_Cons	114.8***	8.705***	0.974*	6.905***
	(11.77)	(2.148)	(0.430)	(1.029)
N	4351054	4351054	4351054	4351054
R-sq	0.107	0.144	0.037	0.092

TABLE IV

	# OFFICE ACTIONS		# RCE		# PROSECUTION TRANSACTIONS	
	Patents	Abandoned	Patents	Abandoned	Patents	Abandoned
MEAN ³¹²	1.694	2.037	0.344	0.301	49.954	37.022
SD	1.601	1.682	0.701	0.653	21.604	19.200
P10	0	1	0	0	28	19
P50	1	2	0	0	44	32
P90	4	4	1	1	75	62
MIN	0	0	0	0	4	4
MAX	25	27	24	14	654	426
N	3,525,385	863,194	3,525,385	863,194	3,525,385	863,194

³¹² The differences between means are significant to $p < 0.001$.

TABLE V

	# PARENTS		# CHILDREN		SMALL ENTITIES	
	<i>Patents</i>	<i>Abandoned</i>	<i>Patents</i>	<i>Abandoned</i>	<i>Patents</i>	<i>Abandoned</i>
MEAN ³¹³	0.844	0.388	0.547	0.0490	0.192	0.295
SD	3.027	0.591	1.9569	0.321	0.4200	0.456
P10	0	0	0	0	0	0
P50	1	0	0	0	0	0
P90	2	1	2	0	1	1
MIN	0	0	0	0	0	0
MAX	400	80	573	43	1	1
N	3,525,385	863,194	3,525,385	863,194	3,525,385	863,194

TABLE VI

	APPLICANT CITATIONS		EXAMINER CITATIONS		102 USES		103 USES	
	<i>Patents</i>	<i>Abandoned</i>	<i>Patents</i>	<i>Abandoned</i>	<i>Patents</i>	<i>Abandoned</i>	<i>Patents</i>	<i>Abandoned</i>
MEAN ³¹⁴	3.445	2.357	1.140	1.384	0.142	0.142	0.332	0.612
SD	13.131	8.749	2.247	2.576	0.425	0.486	0.980	1.382
P10	0	0	0	0	0	0	0	0
P50	0	0	0	1	0	0	0	0
P90	8	6	3	4	0	1	1	2
MIN	0	0	0	0	0	0	0	0
MAX	1545	1448	228	262	135	40	265	89
N	3,525,385	863,194	3,525,385	863,194	3,525,385	863,194	3,525,385	863,194

³¹³ The differences between means are significant to $p < 0.001$.

³¹⁴ The differences between means are significant to $p < 0.001$.

TABLE VII
WORDS IN DESCRIPTION NUMBER OF FIGURES

	<i>Patents</i>	<i>Abandoned</i>	<i>Patents</i>	<i>Abandoned</i>
MEAN ³¹⁵	7,719.93	6,037.77	12.04	9.64
SD	9,056.89	9,801.52	16.04	10.85
P10	2,330	1,754	2	3
P50	5,544	4,415	8	7
P90	14,547	11,439	25	19
MIN	6	10	0	0
MAX	3,892,550	6,467,677	1,652	1,387
N	3,515,790	863,191	3,489,341	785,300

³¹⁵ The differences between means are significant to $p<0.001$.

